JUL 31 1922

Printed on Thin Paper for Foreign Circulation.

The Engineer.

Established 1856. Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXXXIV.—No. 3473] LONDON: FRIDAY EVENING, JULY 21, 1922 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

Chinese Engineering Notes.

Steam Engine Valve Leakage.

The Royal Agricultural Show—No. III.

Vindication of the Capital Ship.

Surface Condensing Plant.

American High-Speed Cruisers.

Centrifugal Castings.

Work of the School of Engineering at Giza, Egypt.

New French Aluminium Bronze Money.

Railway Accidents.

PUBLIC NOTICES

UNIVERSITY OF LONDON.

King's College.

FACULTY OF ENGINEERING.

Complete COURSES of STUDY, extending over either three or four years, are arranged in

CIVIL, MECHANICAL AND ELECTRICAL ENGINEERING.

for the Engineering Degrees of the University of London and for the Diploma and Certificate of the College.

The four years' course provides, in addition to the academic training, opportunity for practical training in "works."

HEADS OF DEPARTMENTS.

Professor G. COOK, D.Sc., A.M. Inst. C.E., A.M.I. Mech. E., Mechanical Engineering.
Professor A. H. JAMESON, M.Sc., M. Inst. C.E., Civil Engineering.
Professor E. WILSON, M. Inst. C.E., M.I.E.E. (Dean), Electrical Engineering.
Professor S. A. F. WHITE, M.A. } Mathematics.
Professor G. B. JEFFERY, M.A., D.Sc. }
Professor SAMUEL SMILES, O.B.E., D.Sc., F.I.C., F.R.S. } Chemistry.
Professor A. J. ALLMAND, M.C., D.Sc., F.I.C. }
Professor O. W. RICHARDSON, D.Sc., F.R.S., Physics.
Professor W. T. GORDON, D.Sc., F.R.S.E., Geology.

Considerable extensions have been made in the Engineering Department. These include a large additional drawing-office, lecture room and laboratory for Hydraulics and Strength of Materials in the Civil and Mechanical Departments; and research rooms, including Wireless Telegraphy, in the Electrical Engineering Department. Large additions have been made to the equipment of the laboratories in the three Departments for purposes of teaching and research. There is a College Hostel and a large Athletic Ground.

For full information apply to the SECRETARY, King's College, Strand, W.C. 2. 8860

University College of Swansea
(A Constituent College of the University of Wales).

APPLIED SCIENCE DEPARTMENTS.

ENGINEERING.

PROFESSOR: FREDERIC BACON, M.A. (Cantab), A.M. Inst. C.E., M.I. Mech. E., M.I.E.E.
LECTURER IN ELECTRICAL ENGINEERING: R. G. ISAACS, B.Sc. (Lond.), A.M.I.E.E.
LECTURER IN CIVIL ENGINEERING: To be appointed.
DEMONSTRATOR: J. SELWYN CASWELL.

METALLURGY.

PROFESSOR: C. A. EDWARDS, D.Sc. (Manchester).
LECTURER: H. I. COE, M.Sc. (Wales and Birmingham).
ASSISTANT LECTURERS: A. L. NORBURY, M.Sc. (Manchester); L. B. PFEIL, B.Sc., A.R.S.M.

The College offers a number of exceptional advantages to students who aim at entering upon professional careers in Engineering or in Metallurgy. It is situated in the heart of an industrial area, which includes a large number of works of very varied character, and presents an unrivalled variety of metallurgical practice. The manufacturers of the district, who contribute largely to the support of the College, give the staff and students of the Applied Science Departments every access to the works, and the managers, engineers and technical officials cooperate with the staff of the College in making visits to works of practical educational value to the students.

Courses of study are provided (1) for the B.Sc. Degree of the University of Wales in (A) Civil Engineering; (B) Mechanical Engineering; (C) Electrical Engineering; (D) Metallurgy; and (2) for Diplomas of the College in (A) Civil Engineering; (B) Mechanical Engineering; (C) Electrical Engineering; (D) Metallurgy.

Persons who are not desirous of studying for degrees or diplomas may attend selected College Classes, provided they satisfy the authorities of the College that they are qualified to benefit by such Classes.

Entrance Scholarships will be offered for competition in September, 1922.

Particulars concerning admission to the College and of the Entrance Scholarships may be obtained from the undersigned.

EDWIN DREW,
Registrar.

University College,
Singleton Park, Swansea. 8826

Borough of Kingston-upon-THAMES.
TECHNICAL INSTITUTE.

WANTED, for the Session commencing September 28th, an INSTRUCTOR in MACHINE DRAWING and DESIGN, for one evening per week.

Salary at the rate of 10s. per hour for the first two hours and at the rate of 5s. per hour for any period exceeding two hours, together with third-class travelling expenses.

Forms of application may be obtained from the undersigned.

H. T. ROBERTS, B.A.,
Principal.

8878

London County Council.

REQUIRED in September next at the School of Building, Ferndale-road, Brixton, a TEACHER of (1) BUILDING SCIENCE, and (2) the CHEMISTRY and PHYSICS of BUILDING MATERIALS, each for one evening a week. Fee, (1) 20s., (2) 5s. Science degree essential, lecturing and teaching experience an advantage.

Preference given to candidates who have served or attempted to serve with H.M. Forces.—Apply, Education Officer (T.I.A.), the County Hall, Westminster Bridge, S.E. 1 (stamped addressed foolscap envelope necessary), for form of particulars, to be returned by 28th July, 1922. Canvassing disqualifies.

JAMES BIRD,
Clerk of the London County Council.

8836

SCIENTIFIC RESEARCH.

The Council of the British Boot, Shoe and Allied Trades' Research Association invite APPLICATIONS for the whole-time POST of DIRECTOR of RESEARCH. Salary £700 per annum plus superannuation payments.

For form of application and particulars apply to the Secretary, Mr. T. A. ROBERTS, Regent House, Kingsway, London, W.C. 2. P5769

PUBLIC NOTICES

G. R.

BY DIRECTION OF THE DISPOSAL BOARD, SOUTHAMPTON.

THE VALUABLE

FREEHOLD ROLLING MILLS,

known as

GOVERNMENT ROLLING MILLS, SOUTHAMPTON,

including certain PLANT.

To be Sold
(by Private Treaty).

SITUATION.—The property is situated in Weston Grove, close to the railway, tram and ferry, and adjacent to the River Itchen, in which is situate a jetty connected with the factory.

AREA OF LAND.—About 82 acres.

BUILDINGS.—The main buildings are of substantial brick construction with Belfast truss roofs, and the property is equipped with the most modern mills and auxiliary plant and machinery.

The principal buildings comprise:—

	Approx. floor area, feet super.
Rolling mills	124,300
Capping shop	74,800
Foundry	74,800
Warehouse No. 1	19,900
Warehouse No. 2	11,200
Warehouse No. 3	12,200
Warehouse No. 4	19,900

TOTAL FLOOR AREA OF MILL ABOUT 337,200 FEET SUPER.

SIDINGS.—Private sidings are laid and arrangements might be made with the railway company for a connection.

POWER AND LIGHTING.—Electric, generated by plant on site.

HEATING.—High and low-pressure steam and hot air systems.

WATER.—From public main and stream.

Further particulars, plan and permits to view may be obtained on application to the CHIEF VALUER, Lands and Factories Section, Disposal Board, Room 279, Carlton House, Tothill-street, Westminster, S.W.1. 8717 I

The South Indian Railway Company, Limited, are prepared to receive TENDERS for the SUPPLY of:—

PUMP and FILTER-HOUSE for the Water Supply of the Trichinopoly Workshops Scheme (Structural Steel Work).

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Pump and Filter-house," must be left with the undersigned not later than Twelve Noon on Friday, the 11th August, 1922.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of the specification.

Copies of the drawings may be obtained at the office of Messrs. Robert White and Partners, Consulting Engineers to the Company, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1
20th July, 1922. 8872

For Advertisement Rates See Page 67, Col. 1.

PUBLIC NOTICES

Aberdeen Corporation Water-WORKS.
EXTENSIONS 1920.
CONTRACT NO. 6.—NEW AQUEDUCT.

The Town Council of Aberdeen are prepared to receive TENDERS from competent persons willing to enter into a contract for the MANUFACTURE and DELIVERY of about 2 MILES of 4ft. Diameter PIPES and SPECIALS of the following alternative types, viz.:—

(A) Cast Iron.
(B) Mild Steel.
(C) Reinforced Concrete—Bonna and Centrifugal Types.
(D) Reinforced Concrete—Ordinary Type.

The drawings may be inspected and specification, schedules of quantities and forms of Tender obtained, on and after 24th July, 1922, on application at the Water Engineer's Office, 41½, Union-street, Aberdeen.

For each specification of each type a deposit of Five Pounds sterling will be required, which sum will, after a Tender has been accepted, be returned to the Tenderer, provided that he shall have sent in a bona fide Tender, based on the drawings, specification and schedule of quantities provided, with the schedule of quantities fully priced out in detail, and shall not have withdrawn the same.

Tenders, on the forms prescribed and enclosed in securely sealed envelopes, endorsed "Tender for New Aqueduct," and addressed to the undersigned, must be delivered not later than 10 a.m. on the 7th August, 1922.

The Town Council do not bind themselves to accept the lowest or any Tender.

GEORGE MITCHELL, M. Inst. C.E.,
Water Engineer.

Water Engineer's Office,
41½, Union-street, Aberdeen,
15th July, 1922. 8877

New South Wales, Australia.
SYDNEY HARBOUR BRIDGE.

Intending tenderers are herby notified that the TIME for RECEIPT of TENDERS for the CONSTRUCTION of the SUPERSTRUCTURE and SUBSTRUCTURE of a CANTILEVER BRIDGE across Sydney Harbour has been EXTENDED by the New South Wales Government until 1st SEPTEMBER, 1923.

T. A. COGHLAN,
Agent-General for New South Wales.

Australia House, London, W.C. 2,
14th July, 1922. 8841

The Great Indian Peninsula RAILWAY COMPANY.

The Directors are prepared to receive TENDERS for the SUPPLY of the following STORES, namely:—

No.		Fee for Specification.
1.	STEEL CHAIRBOLTS	7s. 6d.
2.	BRASS SHEETS, COPPER TUBES, &c.	£1
3.	COPPER PLATES, RODS and INGOTS	£1
4.	ROPES, TWINES, &c.	10s.
5.	SIEVES, &c.	7s. 6d.
6.	LAMPS and FITTINGS	10s.
7.	LAMP GLASSES	7s. 6d.
8.	WICKS, LUBRICATING PADS, &c.	7s. 6d.
9.	STATIONERY, &c.	10s.

Specifications and forms of Tender may be obtained at this office on payment of the fee for the specification, which payment will not be returned.

The fee should accompany any application by post. Cheques and postal orders should be crossed and made payable to the Great Indian Peninsula Railway Company.

Tenders must be delivered in separate envelopes, sealed and addressed to the undersigned, marked "Tender for Steel Chairbolts," or as the case may be, not later than Eleven o'clock a.m. on Tuesday, the 1st August, 1922.

The Directors do not bind themselves to accept the lowest or any Tender.

E. H. WALPOLE,
Secretary.

Company's Offices,
48, Copthall-avenue, E.C. 2,
London, 19th July, 1922. 8879

PUBLIC NOTICES

Metropolitan Water Board.

TENDERS FOR THE SUPPLY AND ERECTION OF DIESEL OR HIGH-COMPRESSION SOLID INJECTION ENGINES WITH WELL AND SURFACE PUMPS AT EYNSFORD, KENT.

The Metropolitan Water Board invite TENDERS for the SUPPLY and ERECTION of TWO DIESEL or HIGH-COMPRESSION SOLID INJECTION OIL ENGINES of approximately 220 B.H.P. each, with WELL and SURFACE PUMPS, &c., at their Eynsford Works, Kent.

Forms of Tender, conditions of contract, specification and drawing may be inspected without payment of fee at the Offices of the Board (Room 182), Chief Engineer's Department, 173, Rosebery-avenue, Clerkenwell, E.C. 1, on and after Monday, 24th July, 1922. Contractors desirous of tendering may obtain the necessary documents from Mr. Henry E. Stilgoe, M. Inst. C.E., the Chief Engineer, on production of an official receipt for the sum of £3 3s., which sum must be deposited with the Board's Accountant and will be returned on receipt of a bona fide Tender, together with all incidental papers. Such payments and applications must be made between the hours of 10 a.m. and 4 p.m. (Thursdays excepted), Saturdays, 10 a.m. and 12 Noon.

Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board, Metropolitan Water Board, 173, Rosebery-avenue, E.C. 1," and endorsed "Tender for Machinery, Eynsford," must be delivered at the Offices of the Board not later than 10 a.m. on Wednesday, 13th September, 1922.

W. MOON,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1,
18th July, 1922. 8875

Metropolitan Water Board.

TENDERS FOR THE SUPPLY AND ERECTION OF PUMPING MACHINERY, SURBITON PUMPING STATION, SURREY.

The Metropolitan Water Board invite TENDERS for the SUPPLY and ERECTION at their Surbiton Pumping Station, Surrey, of ONE STEAM TURBINE with CENTRIFUGAL PUMPS having a maximum capacity of 20 million gallons per 24 hours.

Forms of Tender, conditions of contract, specification and drawings may be inspected without payment of fee at the Offices of the Board (Room 182), Chief Engineer's Department, 173, Rosebery-avenue, Clerkenwell, E.C. 1, on and after Friday, 21st July, 1922.

Contractors desirous of tendering may obtain the necessary documents from Mr. Henry E. Stilgoe, M. Inst. C.E., the Chief Engineer, on production of an official receipt for the sum of £3 3s., which sum must be deposited with the Board's Accountant, and will be refunded on receipt of a bona fide Tender, together with all incidental papers. Such payments and applications must be made between the hours of 10 a.m. and 4 p.m. (Thursdays and Saturdays excepted).

Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board, Metropolitan Water Board 173, Rosebery-avenue, E.C. 1," and endorsed "Tender for Steam Turbine and Pumps, Surbiton," must be delivered at the Offices of the Board not later than 10 a.m. on Wednesday, 13th September, 1922.

The Board do not bind themselves to accept the lowest or any Tender.

W. MOON,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1,
17th July, 1922. 8861

PUBLIC HEALTH ACT, 1875.

Urban District of Greenford,
IN THE COUNTY OF MIDDLESEX.
MAIN SEWERAGE AND DRAINAGE CONTRACTS.
TO SEWERAGE CONTRACTORS.

The Urban District Council of Greenford, acting as the Sanitary Authority for the said Urban District, are prepared to receive TENDERS for certain WORKS of SEWERAGE and DRAINAGE in the said District. The Works generally will consist of (1) Sewers and Engine-house, (2) Outfall Works, (3) Machinery. The approximate total length of sewers will be about 10,500ft. Contractors may Tender for any or all of the above three subdivisions. Particulars, bills of quantities and forms of Tender may be obtained and plans may be seen at the office of the Consulting Engineers, Messrs. Howard Humphreys and Sons, 28, Victoria-street, Westminster, S.W. 1, from Monday, the 24th July, to Wednesday, the 2nd of August, 1922 (inclusive), between the hours of 10 a.m. and 4 p.m., on payment of a deposit of Three Guineas, which intending contractors will be required to deposit with the Engineers prior to particulars being furnished. The said deposit will be returned after the Council have come to a decision on the Tenders received, provided the contractor shall have sent in a bona fide Tender and shall not have withdrawn the same.

The acceptance of any Tender will be made conditional upon the Ministry of Health sanctioning the raising by the Council of a loan for the amount required for the works specified in the accepted Tender.

The successful tenderer will be required to execute a contract deed, the draft of which may be seen at the offices of the Consulting Engineers, when the plans are inspected.

Tenders must be on the official form, each Tender in a sealed envelope marked "Tender for Main Drainage." Contractors must, with the Tender, return the bills of quantities and schedule of prices duly filled in in detail and signed in the handwriting of the tenderer or his authorised agent. Tenders must reach the undersigned not later than 9 a.m. on Wednesday, the 16th August, 1922.

The Council do not bind themselves to accept the lowest or any Tender.

Given under my hand the 13th day of July, 1922.

A. LLOYD JONES,
Clerk of the Council,

40, The Broadway,
Ealing, W. 5. 8864

PUBLIC NOTICES (continued) Page 2.

SITUATIONS OPEN, Page 2.
SITUATIONS WANTED, Page 2.
PATENTS, Page 2.
MACHINERY, &c., WANTED, Page 2.
FOR SALE, Pages 2, 3, and 4.
AUCTIONS, Pages 3 and 94.
PREMISES TO LET OR WANTED, Page 3.
WORK WANTED, Page 4.
AGENCIES, Page 2.
MISCELLANEOUS, Page 2.

NUMERICAL INDEX TO ADVERTISEMENTS Page 93.

PUBLIC NOTICES

City of Edinburgh.
ELECTRIC LAMP STANDARDS FOR STREET LIGHTING.

The Corporation of Edinburgh have FOR DISPOSAL 100-200 ELECTRIC LAMP STANDARDS at an exceptionally cheap rate.

For particulars apply to the Tramways Manager, 2, St. James'-square, Edinburgh.

A. GRIERSON, S.S.C.,
Town Clerk.

City Chambers, Edinburgh,
15th July, 1922. 8876

SITUATIONS OPEN

WANTED, a Qualified, Trained and Experienced ENGINEER and MANAGER to Take Charge of the Manchester Office of a well-known Company whose specialities are the construction of steam turbines, condensing plants, electrical machinery, Diesel and semi-Diesel engines and centrifugal pumps. Public school and university man preferred.

Applicants should have had previous experience in negotiating contracts and be thoroughly good business man with wide connections in Manchester and the surrounding districts.

His chief duties would be the development of the business and to secure orders for the machinery.

Address, with full particulars, stating age and salary required, 8835, The Engineer Office. 8863 A

WANTED, an Experienced ROPEWAY ENGINEER, capable of laying out plants on all systems and with full experience of design and detail of all parts.—Address applications, giving experience and salary, 8610, The Engineer Office. 8610 A

WANTED, Experienced DEVELOPMENT ENGINEER, familiar with Water Gas Hammer Welding. Permanent position in America. State qualifications. Correspondence confidential.—Address, P5766, The Engineer Office. P5766 A

ASSISTANT MARINE ENGINEER REQUIRED for Lighterage and Tugboat Company in North China. Single, age about 25. Three years' agreement at Mex. 300 dols. per month. Unfurnished quarters. Passage paid. Practical knowledge of Docking and Repairing Light-draught Craft and a working knowledge of Pneumatic Tools desirable.—Write, giving experience and qualifications, to "KAOLIN," care Deacon's, Leadenhall-street, E.C. 3. 8874 A

ASSISTANT WORKS MANAGER or FOREMAN REQUIRED for Storage Battery Works in the provinces.—Address, P5784, The Engineer Office. P5784 A

ENGINEER or SUB-AGENT REQUIRED for Harbour Works in a British Colony. Must have been employed on similar works.—Address, with full particulars of experience, P5777, The Engineer Office. P5777 A

LONDON REPRESENTATIVE. — Old-established FIRM of GEARING EXPERTS REQUIRE first-class MAN for London and district. State qualifications, salary and experience.—Address, 8871, The Engineer Office. 8871 A

SIGNAL INSPECTOR REQUIRED for Double Track Lock and Block Systems on Chinese Government Railways. Two years' agreement at salary of £350 and £400; free quarters.—Write, stating qualifications and past experience, age, &c., to "M. E.," c/o J. W. Vickers and Co., Limited, 5, Nicholas-lane, E.C. 4. 8848 A

SMART ESTIMATOR REQUIRED for Elevating and Conveying Plants. Must be thoroughly practical man, accustomed to handling both packages and bulk. Works within 20 miles London. State age, experience, and salary required.—Address, 8867, The Engineer Office. 8867 A

THE RESEARCH ASSOCIATION OF BRITISH MOTOR AND ALLIED MANUFACTURERS, 15, Bolton-road, Chiswick, W. 4.—SENIOR RESEARCH ASSISTANTS REQUIRED, preferably with experience of Automobile Research. Salary £500-£600 according to qualifications.—Apply by letter to the SECRETARY. P5774 A

TRANSFORMER DESIGNING ENGINEER.—APPLICATIONS are REQUESTED for the APPOINTMENT of TRANSFORMER DESIGNER with well-known British firm of electrical engineers.

Applicants must have had first-class experience in the design and manufacture of large High-tension Transformers.

The position would be a permanency and offers ample scope to a suitable man. Applications will be treated with strict confidence.

Address, 8724, The Engineer Office, giving full particulars of experience. 8724 A

TRAVELLERS REQUIRED Throughout Great Britain who are already calling upon General and Motor Engineers, Garages, Ironmongers, Merchants, &c., to SELL on 20 per cent. commission basis the NEW PATENT NEVER SLIP LOCK WASHER, which has a 60 per cent. greater gripping power than the ordinary spring washer. Only men who are determined to stand above the rank and file need apply, as the advertisers have several profitable lines which will be developed in the hands of those whose results prove favourable. Reply, stating age, ground covered, experience, and other lines handled.—Address, 8891, The Engineer Office. 8891 A

3 Experienced MECHANICAL ENGINEERS, Used to routine work, concentrating on mass production; not engineering, but manufactured on high-class machinery, in charge of fitters working 3 shifts of 8 hrs. each. Salary offered £300 per ann. and bonus on production.—Applications, to be accompanied by copies of recent testimonials, to Box F. 323, Lee and Nightingale Advt. Offices, Liverpool. P5757 A

WANTED, DRAUGHTSMAN, Experienced in Heating and Ventilation.—Address in confidence, stating salary required, full particulars of experience, and when at liberty, 8890, The Engineer Office. 8890 A

DRAUGHTSMAN (Constructional Steel and Bridge Work), accustomed to Design Steel Framework for Buildings, &c.; must be well up in theory and practice. Good opening for young, energetic, well-educated man. Give particulars of experience, age, and wages required and when disengaged.—Address, 8873, The Engineer Office. 8873 A

DRAUGHTSMAN (JUNIOR) WANTED, also ASSISTANT ESTIMATOR, for old-established Firm of Railway Wagon Builders in the Midlands. State age, experience, salary required, and when at liberty.—Address, P5781, The Engineer Office. P5781 A

DRAUGHTSMAN REQUIRED IMMEDIATELY, Manchester area, fully qualified in Detailing Steel-framed Buildings, Roofs, &c. Good knowledge of theory necessary. State full particulars and earliest date at liberty.—Address, 8843, The Engineer Office. 8843 A

DRAUGHTSMAN REQUIRED, North-East Coast. Must be thoroughly competent on all classes of Structural Work and Bridge Work; age 30 to 40. Full particulars, stating salary required.—Address, 8775, The Engineer Office. 8775 A

DRAUGHTSMAN REQUIRED, Permanent and Progressive post for a highly competent man who has had considerable experience in Colliery Screening Plant Work. Would be required to act as group leader under chief. State age, salary required, and give full particulars of experience.—NORTONS (Tividale), Limited, Hecla Works, Tipton. 8846 A

ENGINEER AS CHIEF DRAUGHTSMAN.—Owing to the large number of applications, the advertisers regret that it is not possible to reply to each one individually, informing them that the POSITION has been FILLED and thanking them for their applications. Will applicants kindly accept this notice in place of an individual letter. 8828 A

SITUATIONS OPEN (continued)

EXPERIENCED DRAUGHTSMAN, Used to Steam and Electric Cranes and capable of Taking Charge of Juniors. Only first-class men need apply. State age, experience, and salary required.—Address, 8832, The Engineer Office. 8832 A

LEADING DRAUGHTSMAN REQUIRED, to Prepare Designs for Estimates, preferably with knowledge of Structural Work, Gearing and Apparatus for Controlling Water. State age, experience, and salary.—Write, Box 5762, c/o Brown's, 39, Tuthill-street, S.W. 1. 8825 A

A THOROUGHLY COMPETENT FOREMAN WANTED by an old-established Firm manufacturing Steel Castings on the North-East Coast, all classes up to 7 tons in weight; must have held similar position. When applying previous experience must be given and salary required.—Address, 8806, The Engineer Office. 8806 A

PATTERNMAKER (WOOD). State Age and Experience.—Apply, P. J. SMITH, 2a, Wynyatt-street, E.C. 8817 A

SITUATIONS WANTED

ADVERTISER OFFERS His SERVICES to Any important business man with large interests who wishes to unload part of his work and travelling to the shoulders of younger man. Age 36. Thoroughly trained, especially in administration of engineering works. Accustomed to control, preparation of statistics, analysis of results, inaugurating systems, &c. Capable of reviewing and reporting on a business in its entirety. Excellent initiative and organising ability.—Address, P5775, The Engineer Office. P5775 B

BRASSFOUNDER SEEKS SIT; Good All-round man, capable of taking charge; 24 years' practical experience in engineers' jobbing work; age 39.—Address, P5773, The Engineer Office. P5773 B

BUYER.—The MANAGER of a Large Engineering Works Purchasing Dept., who has an exceptionally wide knowledge of the markets of the country, DESIRES to NEGOTIATE NEW APPOINTMENT.—Write, Z. M. 613, c/o Deacon's, Leadenhall-st., E.C. 8799 B

DROP FORGE MANAGER, 25 Years' Experience, good organiser, able to get production, up to date in modern methods, 10 years' experience U.S.A., DESIRES POST, either home or abroad.—Address, P5684, The Engineer Office. P5684 B

ENGINEER (24), Public School Education, Workshop and D.O., steam and oil engines experience, DESIRES POSITION with engineering firm.—Address, P5783, The Engineer Office. P5783 B

ENGINEER (33), Mechanical, Electrical, Experienced in construction and operation of steam and hydro-electric, E.H.T., returning home from Spain in July, SEEKS POSITION at home or abroad; speaks Spanish; excellent references.—Address, 8759, The Engineer Office. 8759 B

ENGINEER, Steam and Automobile, First-class B. of T. certificate and diploma from R.A.C., London. DESIRES RE-ENGAGEMENT; capable supervisor and strict disciplinarian, maintenance; would travel if necessary, transport work a speciality.—Address, P5756, The Engineer Office. P5756 B

EX-OFFICER, G.I. Mech. E., Public School Education, 3 years steam traction, tool-room and maintenance work, WISHES to OBTAIN 6 MONTHS' D.O. EXPERIENCE; very moderate salary.—Address, P5776, The Engineer Office. P5776 B

FORGE MANAGER SEEKS APPOINTMENT where brains, ability and a thorough practical and technical knowledge would be useful; a practical forgeman, with 15 years' experience of management.—Address, P5758, The Engineer Office. P5758 B

HEATING and VENTILATING ENGINEER, Now holding very responsible position, DESIRES CHANGE; 17 years' experience best firms, well connected, fully trained man, conversant with all systems, heating, C.W. supply, cooking, drying, &c.—Address, P5786, The Engineer Office. P5786 B

HEAT TREATMENT SPECIALIST SEEKS EMPLOYMENT, England or abroad. Has held responsible position in massed production shop. Splendid reference.—Address, P5755, The Engineer Office. P5755 B

MECHANICAL ENGINEER, A.M.I.M.E., DESIRES POST as Maintenance Engineer or Assistant. Experienced design, construction and maintenance of steam power plants, machinery layouts for economic production. Excellent references. Age 36.—Address, P5780, The Engineer Office. P5780 B

MECHANICAL GENIUS (Mechanical Engineer) WANTS POSITION, long or short. Well versed in the following subjects:—Steam railroading, bridges, high or very low pressure, hydro-electric, marine construction, concrete, dredging, iron and steel industry. Just returned from U.S.A. and Canada.—T. G. HILL, 260, Kensal-road, Westbourne Park, London, W. 10. P5751 B

PARTNERSHIP OR POSITION. — ENGINEER, M.Sc., A.M.I.C.E., 29 years' varied experience at home and abroad, having capital, DESIRES PARTNERSHIP, Active DIRECTORSHIP, SECRETARYSHIP, or Position with Firm of Contractors or Engineers of good standing, subject to accountants' investigation.—Address, P5743, The Engineer Office, P5743 B

RAILWAY ELECTRIFICATION. — Experienced ENGINEER, accustomed to laying out work and controlling labour, power station and track equipment.—S., 171, Shooters Hill-road, Blackheath, S.E.3. P5759 B

REPRESENTATIVE ENGINEER or Similar COMMERCIAL POST REQUIRED by B.Sc., Civil and Mechanical Engineering, 21 years of age; excellent references.—Address, P5772, The Engineer Office. P5772 B

SCOTTISH ENGINEER (28) SEEKS ENGAGEMENT as Works Manager or Assistant. Works management experience at home and abroad. Knowledge Portuguese and Spanish, erecting machinery at present, free Sept.—Address, P5761, The Engineer Office. P5761 B

TO MANUFACTURERS.—MECHANIC (26), Healthy, SEEKS APPOINTMENT anywhere. Good fitter and turner, experience in large manufactory with steam, electric and hydraulic power, general repairs, maintenance, installations, machine shop practice, refrigeration.—Address, P5785, The Engineer Office. P5785 B

DRAUGHTSMAN (Advanced Junior); 7 Years' experience, accustomed to jig, tool, machine work and detailing, &c.; slight workshop and technical training.—W. GREEN, 582, Barking-road, Plaistow, London, E. 13. P5779 B

DRAUGHTSMAN (Junior) REQUIRES POSITION; 5 years shops (practical), 3 years D.O. (technical and practical), neat and accurate tracer; moderate salary when experience could be gained.—Address, P5771, The Engineer Office. P5771 B

JUNIOR DRAUGHTSMAN (21) REQUIRES SITUATION; 7 years' experience in general engineering and furnace construction; good references.—M. C. S., 205, Links-road, Streatham-road, S.W. 17. P5778 B

FOUNDRY FOREMAN, Iron, Brass or Aluminium, SEEKS BERTH with small progressive firm; all classes of work; good organiser and expert metal mixer.—Address in confidence, P5754, The Engineer Office. P5754 B

PARTNERSHIPS

ENGINEERING PARTNERSHIPS AND BUSINESSES.

Wheatley Kirk, Price & Co.,
46, Watling Street, London, E.C. 4.

Established seventy years.

SECRETARY DIRECTOR REQUIRED; Preferably one with knowledge of engineering, London company. Investment £2000, secured by debenture. Salary £520 p.a. Interest 10 per cent. plus commission. Present directors have £16,000 cash invested. Open to accountants' investigation.—Write, Box 42, Wilson Bell Publicity, Ltd., 83, Pall Mall, S.W. 1. 8803 C

AGENCIES

BELGIAN, Licencie en Sciences Commerciales (B.C.), serious and energetic, 40 years old, visiting regularly important steel works and others, WISHES to REPRESENT BRITISH FIRMS who have anything suitable to offer.—Write to initials, A. G. ECLAIR PUBLICITE, Charleroi (Belgique). 8847 D

ENGINEER, Young and Energetic, with Valuable and well-established connection amongst engineering and other large concerns in Lancs. and Chesh., DESIRES ONE or TWO First-class AGENCIES. Office with 'phone in Manchester.—Address, P5764, The Engineer Office. P5764 D

LONDON.—ENGINEER, Well Established (Good office and exhibiting facilities), wide commercial experience, is OPEN to REPRESENT and ACT for Manufacturers and Engineering and Allied Firms.—Address, 8562, The Engineer Office. 8562 D

REPRESENTATION.—A Well-known FIRM of ENGINEERS and EXPORTERS with connections in South Africa and offices in Westminster, would be pleased to act as AGENTS for ENGINEERING FIRMS desirous of extending their business.—Address, 8855, The Engineer Office. 8855 D

RUSSIA.—B.Sc., Engineering, With Sound Knowledge of Russian, Captain Indian Army retired, WISHES to REPRESENT a BRITISH ENGINEERING FIRM in Russia.—Address, 8857, The Engineer Office. 8857 D

EDUCATIONAL

CORRESPONDENCE COURSES for Inst. C.E., Inst. Mech. E., London Univ. (Matric., Inter., and B.Sc.) personally conducted by Mr. TREVOR W. PHILLIPS, B.Sc. (Honours), Assoc. M. Inst. C.E., M.R.S.I., F.E.S.A., &c. Also Day Tuition in Office. Excellent results at all Exams. Courses may commence at any time.—8/11, Trafford Chambers, 58, South John-street, LIVERPOOL. Ex.

LEARN SURVEYING AND LEVELLING. — Thorough practical instruction given by an expert.—Address, E. MOUL (late L.S.W. and S.P.D. Rlys.) Hollybank, Woking. £5097 B

TUITION BY POST.—Inst. C.E. and I. Mech. E. Enrol now for next Exams.; 100 per cent. passes last examination. Reinforced Concrete, new comprehensive course under expert engineer, £5 5s. Write for particulars.—PENNINGTONS, University Tutors, 254 Oxford-road, Manchester. Estab. 1876. Ex.

MISCELLANEOUS

ADVERTISERS are BUYERS of Used RAPE OIL, such as has been used for tempering work, &c. Advise quantities available and price.—Address, 8278, The Engineer Office. 8278 I

BELGIAN CONSTRUCTOR, Having Standard Machinery, would like to be in TOUCH with ENGLISH FIRM for serial works concerning construction of motor cars, motor cycles, machine tools, gas and petrol motors, electrical apparatus and cable, &c. Quick delivery and highly finished.—E. D., 40, Denton-road, Twickenham. P5735 I

BLUE PRINTS and DRAWINGS PHOTOGRAPHED WHILE YOU WAIT.—COMMERCIAL CAMERA CO., 40, Strand. 8827 I

CIVIL ENGINEERING FIRM DESIRED to CONSIDER PLAN of CROSS-RIVER COMMUNICATION.—Box 2016, c/o Dixon, 195, Oxford-street, W. 1. P5760 I

DRAWINGS and TRACINGS of all Descriptions. Machines dismantled and working drawings made by competent draughtsmen, promptly and cheaply.—W. E. LAVERICK & CO., 11, Fonnereau-rd., Ipswich. P5670 I

ENGINEER is FREE to UNDERTAKE TRACINGS, any kind; also Drawings and Design Structural and General Mechanical, no internal combustion or electrical; moderate charges.—Address, P5667, The Engineer Office. P5667 I

FACTORY ORGANISATION FOR MASS PRODUCTION.

Are your machines the most suitable? Is your "lay-out" the best obtainable? Are your methods the most efficient? Can your manufacturing costs be reduced, your output increased or quality improved?

ADVERTISER, M.I. Mech. E., with many years' experience of production in quantity of accurate interchangeable work, is PREPARED to INSPECT and REPORT on these points.

Address, P5779, The Engineer Office. P5779 I

OLD-ESTABLISHED FIRM of ENGINEERS, with foundry in London, WISH to TAKE UP the MANUFACTURE of SPECIAL or PATENT MACHINERY. Principals only dealt with.—Write, Box 1813, Harrison and Sons, Ltd., 44-47, St. Martin's-lane, London, W.C. 2. 8880 I

FOR HIRE

FOR HIRE, PUMPS and WELL-BORING TOOLS for Contractors' Deep Wells, &c., 2in. to 24in. dia.—E. RICHARDS and CO., Upper Ground-street, London, S.E. Telephone No. 978 Hop. 822 G

FOR SALE or HIRE, ELECTRIC MOTORS from 60 to 300 H.P.; PORTABLE STEAM ENGINES from 8 to 40 N.H.P.; STEAM BOILERS, CRANES, PUMPS, MACHINE TOOLS of every description; reasonable terms, immediate delivery.—J. T. WILLIAMS and SONS, 57, Queen Victoria-street, London, E.C. Tel., City 3938. Ex.

MACHINERY, &c., WANTED

WANTED IMMEDIATELY, NEW or SECOND-HAND BOILER, Loco. Type, about 150 lb. pressure, to drive 250 H.P. engine.—JOHN BOARD and CO., Ltd., Dunball, Bridgwater. 8849 F

WANTED IMMEDIATELY, Second-hand Combined PUNCHING, BAR CROPPING and PLATE SHEARING MACHINE, suitable for shearing plates up to 5-8in. thick.—Address, 8886, The Engineer Office. 8886 F

WANTED in London District, CRANE on HIRE, either hand or electric, 5th 45ft. to 50ft. long, and capable of lifting 15 to 20 tons. Will be required from September for lengthy period.

Reply, stating terms and where can be inspected, to Box 67, Wheeler's Advertising Agency, Manchester. P5762 F

WANTED, ONE SINGLE-CHAIN PRIESTMAN GRAB, one yard capacity.—Please send price and full particulars to 8862, The Engineer Office. 8862 F

ANGLE BENDING MACHINE WANTED for Bending mild steel sheets up to 30in. wide and 1-8in. thick.—Write, Box 461, Sell's Advertising Offices, Fleet-street, E.C. 4. 8845 F

PATENTS

ENDLESS STEEL BELTS.—The OWNER of BRITISH PATENT No. 147,667, which relates to the manufacture of Endless Steel Belts by Rolling from Seamless Tubing, is DESIROUS of ENTERING into NEGOTIATIONS for the GRANTING of LICENCES thereunder on reasonable terms.—Communications please address to DICKER and POLLAK, 20-23, Holborn, London, E.C. 1. 8844 H

THE PROPRIETOR of BRITISH PATENTS Nos. 128,044, dated July 15, 1918, and 131,985, dated July 31, 1918, relating to "Improvements in Heat-retaining Bottles for Use on Aeroplanes" and "Improvements in Heat Insulated Containers" respectively, is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patents and ensuring their practical working in Great Britain.—Inquiries to be addressed to H. SINGER, Steger Building, Chicago, Ill. 8764 H

THE PROPRIETOR of BRITISH PATENT No. 138,873, dated August 5, 1915, relating to "Improvements in Welding of Railway Rails," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to H. SINGER, Steger Building, Chicago, Illinois. 8798 H

THE PROPRIETOR of BRITISH PATENT No. 20,891/12, dated September 13, 1912, relating to "Improvements in Boiler Cleaning Apparatus," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to H. SINGER, Steger Building, Chicago, Illinois. 8797 H

THE PROPRIETORS of LETTERS PATENT No. 122,835, relating to

MEASURING SET FOR MEASURING AND CONTROLLING ANGLES.

DESIRE to DISPOSE of their PATENT or to GRANT LICENCES to interested parties on reasonable terms with a view to the adequate working of the patent in this country.—Enquiries to be addressed to

CRUIKSHANK and FAIRWEATHER,
65-66, Chancery-lane, London, W.C. 2. 8830 H

THE PROPRIETORS of LETTERS PATENT Nos. 16,736/1913, relating to THREADING DIES;
10,830/1915, relating to TURRET LATHES;
101,599, relating to TURNING LATHES;

DESIRE to DISPOSE of their PATENTS or to GRANT LICENCES to interested parties on reasonable terms with a view to the adequate working of the patents in this country.

Enquiries to be addressed to

CRUIKSHANK and FAIRWEATHER,
65-66, Chancery-lane, London, W.C. 2. 8830 H

THE PROPRIETORS of LETTERS PATENT No. 22,312/1912, relating to

THREADING DIES,

DESIRE to DISPOSE of their PATENT or to GRANT LICENCES to interested parties on reasonable terms with a view to the adequate working of the patent in this country.—Enquiries to be addressed to

CRUIKSHANK and FAIRWEATHER,
65-66, Chancery-lane, London, W.C. 2. 8850 H

THE PROPRIETOR of 17 BRITISH and FOREIGN PATENTS, with Freehold Engineering Works near London, WISHES to MEET young energetic ENGINEER with £5000 upwards to MARKET his INVENTIONS. Full particulars to interested party.—Address first instance, 8894, The Engineer Office. 8894 I

FOR SALE

A LEADING LIST

OF NEW and SECOND-HAND MACHINERY can be obtained from W. H. PEASE and CO., Ltd., Hastings House, Norfolk-street, London.

TELEGRAMS: "ENGIPEASE, ESTRAND," LONDON.

SEE OUR ADVERT. ON PAGE 42 OF THIS ISSUE.
Ex.

ACCUMULATOR, by Berry, 8in. Ram, 9ft. 6in. high, with 17 cast iron weights, 8ft. 9in. dia. by 4in. thick, weight with cylinder about 14 tons; also SET of THREE-THROW HYDRAULIC PUMPS to work above; all equal to new.—JOYCE, White Hart-lane, Tottenham. P5766 G

BABCOCK-WILCOX Standard LAND BOILER, fully mounted, capacity 3500 lb. of steam per hour at 200 lb. pressure, fitted with self-contained superheater, FOR DISPOSAL at Engineering Laboratory, University College.—For full particulars apply, the SECRETARY, University College, London, Gower-street, W.C. 8812 G

BOILERS FOR SALE.—THREE High-class LANCASHIRE BOILERS, 30ft. by 9ft. (no cross tubes), 30ft. by 8ft. 9in. (no cross tubes), and 30ft. by 8ft. All complete with fittings and mountings ready for work and passed to re-insure at 100 lb. pressure. Prices right.—JOSEPH POOSLEY and SONS, Ltd., Cattybrook Ironworks, Lawrence Hill, Bristol. 8851 G

BOILER, Vertical Type, FOR SALE, 4ft. by 2ft., pressure to 60 lb., ready for immediate use, perfect condition, all fittings, including 40ft. of chimney. Best offer.—W. DOWNS, Ltd., Hampton-street, Walworth, S.E. 8892 G

For continuation of For Sale Advertisements see page 3.

An American High-speed Cruiser and its Prototype.

IN the American three-year naval programme, adopted in 1916, provision was made for the construction of ten light cruisers, a type of vessel in which the United States Navy was very deficient. Owing to America's entry into the war, which occurred eight months afterwards, the commencement of these cruisers was much delayed, for priority was wisely given to the production of destroyers and other craft which were urgently needed to combat the submarine menace. The keel of the first ship, the Omaha, was not laid till December, 1918, and the contract called for delivery by August, 1921; but through various causes the building period has been retarded, and it is now improbable that the Omaha will be ready for her trials before the late summer of this year. We are officially informed by the United States Navy Department, under date of April 20th, that work on the ship was then in suspense and could not be resumed until Congress had authorised an increase in her limit of cost. The lower of the two views on page 66 was taken on January 25th last, and shows the Omaha lying in the fitting-out basin at the Tacoma yard of the Todd Shipbuilding Corporation, where she was built. It will be noticed that the vessel was then in an advanced state of completion, with most of her superstructure and armament in place, though the twin 6in. turrets at bow and stern had still to be put on board. The upper illustration on page 66 shows the appearance of the ship as she will be when completed, according to an official drawing, for which we are also indebted to the Navy Department.

The Omaha and her nine sisters, of which three or four have yet to be launched, represent a new and interesting type of light cruiser, in which an attempt has been made to combine very high speed with good sea-keeping qualities, wide range of action, a powerful armament, and robust protection. As the design, which has undergone certain modifications since it was originally got out, has already been described in these columns, we need only repeat the leading particulars, which are as follows:—Length between perpendiculars, 550ft.; length overall, 555½ft.; beam, 55ft.; mean draught, 14ft. 3in.; normal displacement, 7500 tons. The machinery—see Figs. 1, 2, and 3—which is designed to work up to a maximum of 90,000 shaft horse-power, consists, in the case of the Omaha, of four 22,500 shaft horse-power cross-compound Westinghouse turbines, with reduction gears of the floating-frame type, each of which has two pinions, one for the high-pressure and one for the low-pressure rotors, connected to the propeller shaft by a single gear wheel. The range of speed is from 12 to 33.7 knots with the main turbines in action, but for purposes of economy at low cruising speeds four cruising turbines are fitted, each consisting of a single-row impulse wheel developing 420 shaft horse-power at 6000 revolutions per minute. These cruising turbines, which are mounted on an extension of the casings of the main high-pressure elements, can be coupled to the high-pressure rotor by gearing which gives a speed reduction of 6 to 1. The twelve Yarrow boilers are situated in four compartments, three boilers being placed abreast in each, the four sets of geared turbines being in two engine-rooms. The advantage of this arrangement is that damage to one important bulkhead would not disable more than half the machinery, but the drawback is that it involves placing two sets of boilers above the wing shafts. In these ships the ratio of length to depth is considerable and the stresses accepted are very high. It is understood they have been strengthened, particularly at the fore end of the forward boiler-room, where, owing to the termination of the side plating, there was ominous discontinuity of strength.* Exact details of the protection are withheld, but amidships for one-third of the length of the hull there is a thin armour belt of considerable depth, associated with a complete steel protective deck. The main armament comprises twelve 6in. 53-calibre guns, four of which are paired in turrets at bow and stern and the remaining eight mounted in single casemates, the disposition of which can be seen from the official sketch. All twelve guns are thus completely enclosed by armour of sufficient strength to resist splinters, if not direct hits, and this feature alone, which is fully in accord with the teachings of war experience, renders the ships unique in the light cruiser category. It must be admitted, however, that the distribution of the armament, allowing as it does only eight out of twelve guns to be trained on either broadside, would not find favour in the British Navy, where the opinion prevails that every modern fighting ship should be able to use her full main armament on both broadsides. Should the Omaha attain her designed speed of 33.7 knots, she will be the fastest light cruiser in the world, in which case the United States Navy will enjoy once more a distinction which it gained more than fifty years ago by the completion of the Wampanoag. It seems to us, therefore, that the present is a fitting occasion to recall the performance of a ship which, although it constituted a distinct landmark in the history of marine engineering, is almost forgotten to-day.

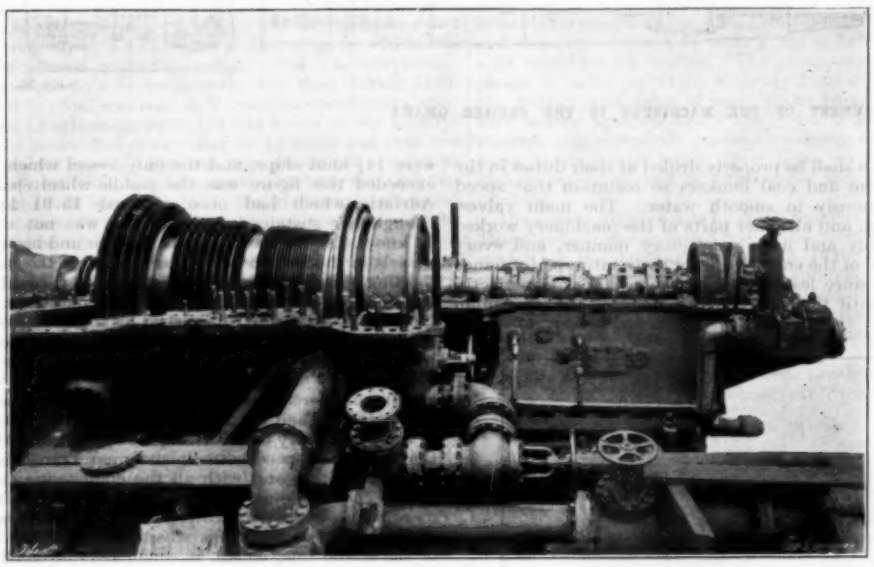


FIG. 1—TURBINE OF THE UNITED STATES CRUISER OMAHA

THE WAMPANOAG OF 1864.

The Wampanoag—Fig. 4—was one of a group of seven vessels which were designed and laid down by the Federal Government during the Civil War, ostensibly for the purpose of chasing Confederate raiders of the Alabama type, but in reality to serve as a menace to the shipping of Great Britain, whose relations with the United States at that period were not of the most cordial description. In his annual report for 1863, the Secretary of the United States Navy made the following observation: "Besides turreted vessels for coast defence and large armoured ships for naval conflict, we need and should have steamers of high speed constructed of wood, with which to sweep the ocean and chase and hunt down the vessels of an enemy." Pursuant to this recommendation, seven large ships, to be fitted with machinery of abnormal power for those days, were shortly afterwards ordered, their names being Idaho, Madawaska, Wampanoag, Chattanooga, Pomponoosuc, Ammonoosuc, and Neshaminy. None was completed in time to take part in the war, and before the first of them was ready to make her trials naval opinion had veered round to the view that the ships were more or less useless, and simply fragile boxes of machinery without serious fighting value. The Wampanoag and her sisters, therefore, made their *début* under a cloud, and were regarded as so many white elephants which had cost a great deal of money without bringing any appreciable return. Unfortunately, this disparaging opinion was largely confirmed by the disappointing results of their steam trials, only two of the vessels, namely, the Wampanoag and the Ammonoosuc, reaching the contract speed. All the others proved very slow. Consequently, in spite of the brilliant success of the Wampanoag, the whole class fell into disrepute and soon disappeared from service, the striking performance of one being overshadowed by the almost uniform failure of the rest. These ships, nevertheless, were the prototype of the modern high-speed cruiser, a fact which has been acknowledged by many authorities, including the late Lord Brassey†; and they have, moreover, a further claim upon our interest as having been responsible for the construction of the first large unarmoured ships of high speed that were added to the British Navy—the Inconstant, which was laid down here in November, 1866, having been expressly designed as a "reply" to the fast American vessels then completing, as regards the formidable qualities of which many sensational reports had gone the round of the English Press.

The Wampanoag and the Madawaska were laid down simultaneously at Brooklyn in 1864, and were practically identical in dimensions, those of the former being as follows:—Extreme length of spar deck, 342ft. 8in.; extreme breadth, 45ft. 2in.; depth of hold, 23ft. 6in.; draught, 19ft.; tonnage (old measurement), 3281 tons. The machinery—Fig. 5—was designed by Mr. B. F. Isherwood, who was then chief of the Bureau of Steam Engineering, and recognised as one of the most experienced and progressive marine engineers of his day. The propelling plant consisted of two geared direct-acting engines with one surface condenser to both engines; two cylinders of 100in. diameter and 48in. stroke. The gear wheels, which were wood-toothed, transmitted 2.05 revolutions to the propeller shaft for every double stroke of the piston, the propeller being 19ft. in diameter. Steam was supplied to the main and auxiliary engines by eight vertical tubular boilers and four "superheating" boilers, with an aggregate grate area of 1128 square feet and a water-heating surface of 30,588 square feet. Boilers of similar type were installed in the Madawaska, but the propelling machinery of that ship was designed by the famous John Ericsson, on his well-known vibrating lever system, and were connected directly with the shaft. Of the Madawaska it need only be said that she was practically a failure, for instead of the contract speed of 15 knots she made less than 14 knots when on trial.

The Wampanoag was not completed till early in 1868, and put to sea from New York for her trial trip on February 7th of that year, with her armament

FIG. 2—GEAR WHEELS FOR THE CRUISER OMAHA

* Mr. S. V. Goodall, R.C.N.C., in lecture to Portsmouth Engineering Society, January 31st, 1922.

† Brassey: "The British Navy," p. 477 *et seq.*

(sixteen large-calibre smooth-bore guns mounted on the broadside at upper deck level, and one 60-pounder rifled pivot gun in the bows), all stores, and a full complement on board. The principal results are set forth in the following extract from an official report signed by the three senior engineer officers who were present at the trials.

"The vessel was driven at maximum speed, under steam alone, during 37½ consecutive hours; and at the speed of 11 knots, under steam alone, during 25 consecutive hours; the latter performance being to ascertain with what consumption of coal per hour the speed of 11 knots can be maintained at sea. The average performance during the 37½ consecutive hours of maximum speed was as follows:—

Average speed of vessel per hour, in nautical miles	16.71
Average speed of vessel per hour, in statute miles ..	19.265
Average number of engine revolutions per minute ..	31.06
Average number of screw revolutions per minute ..	63.673
Average steam pressure in boilers, pounds per square inch	31.97
Average position of the throttle valves	Wide open
Average consumption of coal, in pounds per hour ..	12,690

"There was a fresh breeze abaft the beam, with a moderate sea most of the time on the quarter; the latter part of the trial the sea was heavy. During the above maximum performance the vessel averaged, for twenty-four consecutive hours, 16.97 knots, or 19.566 statute miles per hour; during twelve consecutive hours, 16.98 knots, or 19.577 statute miles; and during six consecutive hours, 17.25 knots, or 19.89 statute miles per hour. The greatest distance run in any one hour was 17.75 knots, or 20.465 statute miles; the latter speed was obtained and logged four separate half-hours, and it is only necessary that the men shall be properly drilled at their duties in the fire-room and coal bunkers to maintain that speed continuously in smooth water. The main valves, gearing, and all other parts of the machinery worked smoothly and in a satisfactory manner, and every journal of the engines during their entire performance at sea since leaving the navy yard worked perfectly cool until the thirty-eighth hour of the maximum speed trial, when the crank pin of the after engine began to warm; the speed of the engines was then reduced by throttling, the first and only time for any requirements of the machinery. The warming of the crank pin did no injury whatever, nor would it have been the cause of a non-completion of the forty-eight hours' trial at maximum speed. There was no foaming or priming in the boilers; the performance of the whole machinery was excellent, and it returned to port in a condition for any service without requiring repairs. The maximum performance can be easily maintained during a passage across the Atlantic, or for any required service, and we are of opinion that it is not equalled for speed or economy by that of any sea-going screw vessel of either the merchant or naval service of any country."

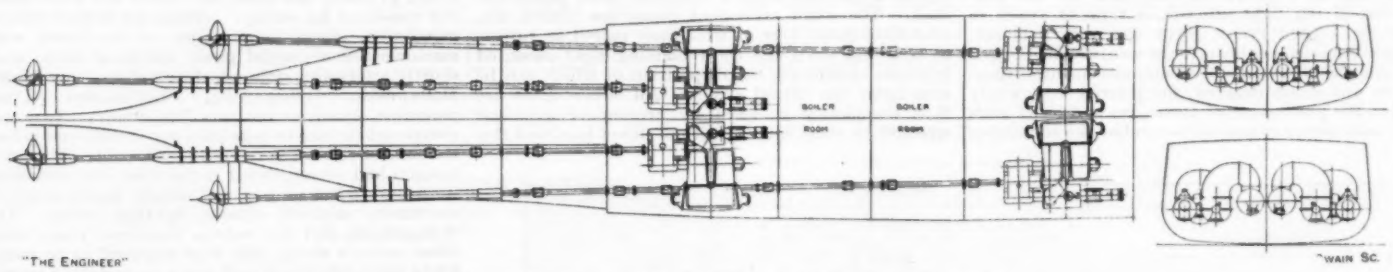


FIG. 3—ARRANGEMENT OF THE MACHINERY IN THE CRUISER OMAHA

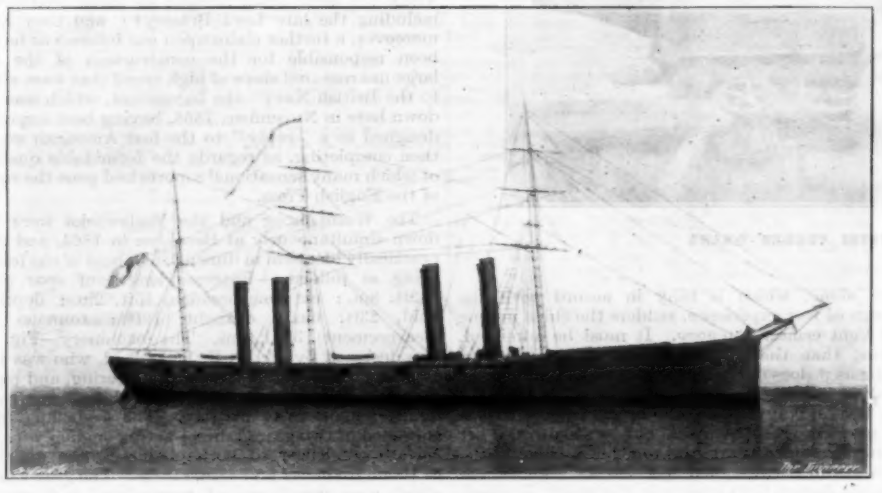


FIG. 4—THE UNITED STATES FAST LIGHT CRUISER WAMPANOAG, 1868

To appreciate the extraordinary achievement of the Wampanoag in maintaining for 37½ hours a mean of 16.71 knots and reaching a maximum of 17¾ knots, it is necessary to recall the best performances of contemporary vessels. The fastest ocean liners of 1868 were 14½-knot ships, and the only vessel which had exceeded this figure was the paddle-wheel steamer Adriatic, which had once attained 15.91 knots, though her sustained speed at sea was not above 14 knots. As for warships, the Warrior and her sister vessels in the British Navy were probably the fastest fighting ships then in existence, yet they could not steam above 14¼ knots in favourable conditions. In fact, the speed record established by the Wampanoag remained untouched for ten years, when it was beaten by the British steel-built dispatch vessels Iris and Mercury.

"In commercial life, speed at sea has always been a prime factor, and the most flattering circumstance in the whole story of the Wampanoag is that with all the rivalry for speed between the great Transatlantic steamship lines, and with all the engineering talent of two continents at work upon the problem, it took more than eleven years to produce an ocean steamer that was her equal. This steamer was the Arizona of the Guion line, which, in June, 1879, crossed the Atlantic at an average speed of 16.6 knots; this remained the fastest Atlantic passage for more than two years, when the Arizona herself lowered it by about two hours in the whole time of crossing. The first steamer to land passengers at New York on the same day of the week after leaving Europe was the Alaska, also of the Guion line, in 1882, and her best day's run on that voyage was 419 sea miles, not much in excess of the 405 knots made by the Wampanoag during the first twenty-four hours of her trial trip, and probably not as much when allowance is made for difference in time due to the Alaska's westing."‡ Contrary to adverse reports which were circulated by opponents of the fast cruiser type, the Wampanoag appears to have had a fairly extensive endurance for a vessel of her relatively enormous speed. The average consumption of coal per day was 45 tons at 11.3 knots and 138 tons at 17 knots, and her commanding officer estimated that the coal supply was sufficient for steaming five or six days at maximum power. This, however, would have meant a supply of 690 to 830 tons, and it is very doubtful whether the bunkers could have taken such a quantity of coal at one load. Still, there is no doubt that the Wampanoag would have been a most formidable opponent to any Power that owned a large mercantile marine, against which she could probably have operated with far greater effect than the Alabama had done against Federal shipping. She was fast enough to overtake or elude any merchantmen or warship then in existence, and her battery was sufficiently powerful to enable her to engage most of the unarmoured cruisers of that period with a good chance of success.

‡ Bennett: "The Steam Navy of the United States."

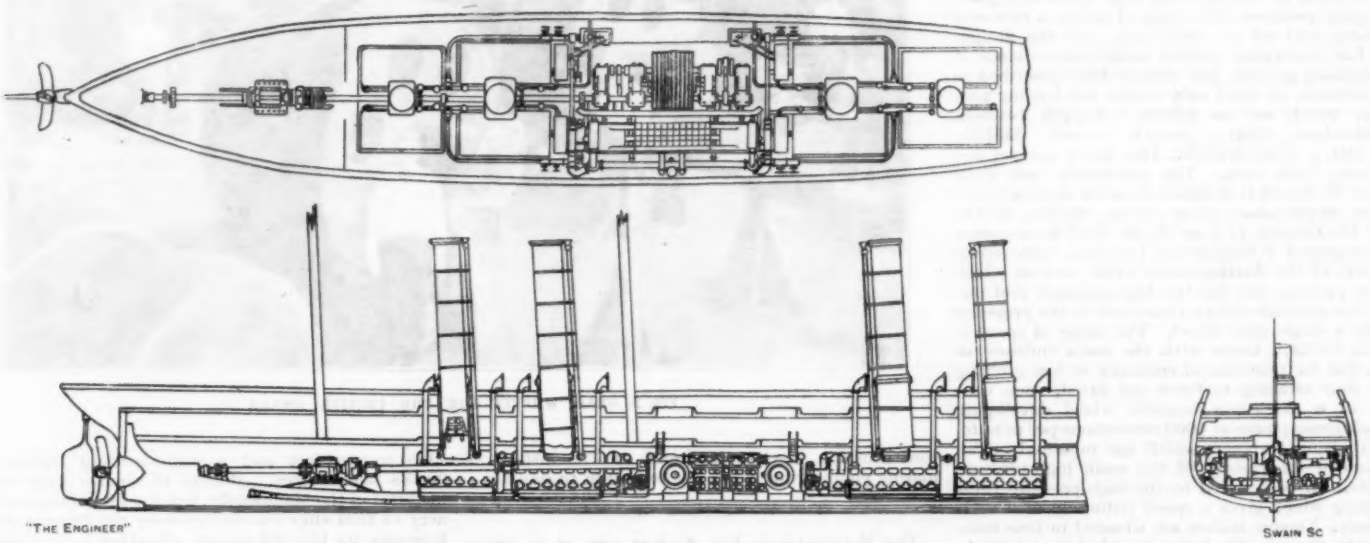


FIG. 5—ARRANGEMENT OF THE MACHINERY IN THE CRUISER WAMPANOAG, 1868

As stated above, however, only a very brief career was vouchsafed to this notable ship. In 1869 she was renamed the Florida, and was shortly after condemned as unsuitable for naval purposes by a board of officers, who made it clear in their report that they regarded speed as of negligible importance, and apart from that quality the Wampanoag had few claims to consideration. Having been laid up for several years, she was used for a time as depôt ship, and finally, in February, 1885, was sold to the shipbreakers for 41,508 dols., or less than 3 per cent. of her original cost of 1,575,643 dols. "It was the fate of the Wampanoag to live too soon, before the world was ready for the era which her creation heralded, and for that reason she has been almost forgotten."

The fate of the six other vessels of this type may be briefly reviewed. The Idaho, after failing lamentably on her steam trials, was stripped of her machinery and converted to a full-rigged sailing ship, in which *rôle* she proved exceedingly fast. She was irreparably damaged by a typhoon in the Far East during 1869, and her hull was sold at Yokohama some years later. The Chattanooga averaged 13½ knots on her twenty-four hours' full-power trial, or 1½ knots less than the contract speed. She was then placed out of commission until 1871, when she sank in harbour from injuries to the hull caused by ice. The Madawaska averaged less than 13 knots on trial, though for one hour she touched 16 knots. Her name was then changed to Tennessee, and in 1872–74 she was re-engined, but again failed to make the contract speed. After a period of service as flagship, first on the Asiatic station and then in the North Atlantic, she was condemned and sold in 1887. The Secretary of the Navy, in his report for that year, remarked: "She had a short life, but, as a consumer of money, a brilliant one." From beginning to end this ship had cost the United States Government about 3,800,000 dols. The Ammonoosuc, which made her trials in June, 1868, was prevented by fog from completing them, but on a run of 50 sea miles she averaged 17.11 knots. This excellent performance, however, did not save her from the fate of the others. With her name changed to Iowa she was left to rot at her moorings till 1883, when she was sold out of the service. The Neshaminy was duly completed, but as no details of her trials are available, she was presumably not a success. Her name was changed to Nevada, and in 1874 she was sold for 25,000 dols. The Pomponoosuc, whose name was subsequently altered to Connecticut, was never completed, and having stood in frame on the stocks at Boston for many years, was finally broken up.

The Royal Show at Cambridge.

No. III.*

A steam wagon of new design to carry a 7-ton load was shown by the Yorkshire Patent Steam Wagon Company, Leeds, the chief feature of which is the novel arrangement of the motive and transmission mechanism. The engine is of the vertical compound balanced type of 50 horse-power, fitted with piston valves and reversing gear, and all the working parts are enclosed in an oil-tight casing to which access is easily attainable. Instead of being arranged transversely in the chassis, the centre line of the crank shaft coincides with that of the vehicle in plan, and the power of the engine is transmitted to the rear axle through a gear case which gives three speeds of progression. The gear case is spigoted to the engine casing, keeping all parts in alignment, and the gear wheels run in an oil bath similar to the usual petrol vehicle gear case. The hind axle is a mild steel drop forging, bored through the centre and fitted with spline shafts which have nothing to do but transmit the drive to the road wheels from the differential gear and enclosed cardan shaft. The boiler is of the horizontal fire-tube pattern arranged transversely across the front of the machine, and the engine is fitted with a by-pass to admit high-pressure steam to the low-pressure cylinder when required. The general design gives a very pleasing and straightforward appearance.

A special feature of the stand of Robert Boby, Limited, Bury St. Edmunds, was a new pattern hurricane winnower, which has been introduced to meet the demand for a low-priced but efficient machine. This appliance is provided with a full range of screens and sieves to meet the requirements of this branch of industry for dealing with wheat, barley, oats, rye, maize, peas, &c., and is specially suited for the export trade. A new design of polishing machine for grain was also shown by Messrs. Boby.

Worthington-Simpson, Limited, Newark-on-Trent, showed, in addition to a range of oil engines and lighting sets, a high-speed motor-driven hydraulic pump of the horizontal single-plunger type. This pump is a self-contained unit with all the moving parts completely enclosed in an oil bath. It can be driven either by an oil engine or electric motor, and since it is designed for a speed of 550 revolutions per minute, it can be directly coupled to an oil engine without the intervention of belting or gearing. It is designed for a pressure of 75 lb. per square inch, and the plunger diameter is 2¾in., with a stroke of 1¾in. It will deliver 20 gallons of water per minute, and is specially intended for domestic purposes or small factories. Air chambers of ample size are provided on both the suction and discharge branches.

In the flour-milling section of the show, Messrs. E. R. and F. Turner, Limited, Ipswich, had an extensive display, a particular feature of which was a diagonal flour roller mill with two pairs of smooth rolls 40in. long by 10in. diameter for reducing grain to flour after the bran has been removed on the break system. Each side of the mill is fitted with corrugated double-feed rolls. One of the most recent improvements introduced into this mill is the gear drive to the feed rolls, giving a fixed differential according to the speeds required for each particular kind of feed. Other machines shown by Messrs. Turner were a patented planscourer and a vibro-planscourer, the latter being a smaller edition of the former, and suitable for smaller mills. Their object is the scouring and cleaning of wheat or other grain to bring it into a fit condition for milling. The grain travels along planes in boxes to which a rotary motion is given, the bottom and sides of each plane being covered with emery against which the grain is constantly thrown, and thrashed, gradually passing along and down through the boxes, dust being extracted at various stages as well as small seeds and other impurities.

The potato digger made by A. C. Bamlett, Limited, Thirsk, which was awarded one of the Society's silver medals at the Darlington show in 1920, has been re-designed in certain parts. The spinning gear has been modified to combat the wear and tear which takes place owing to the entry of grit into the bearings. The latter have been shrouded, and a better system of lubrication is provided than formerly.

H. G. Burford and Co., Limited, London, showed a miniature model of the Cletrac petrol tractor built on the chain track principle. It weighs considerably under a ton, and is propelled by a four-cylinder vertical engine with 3¼in. bore by 4½in. stroke, the speed being 1600 revolutions per minute. This engine gives 9 horse-power at the draw bar and 16 horse-power at the belt pulley. It is 83in. long, and can turn in a circle of 8ft. radius. The traction surface is 470 square inches, giving a weight of 4 lb. per square inch on the track. A silver medal was awarded to W. N. Nicholson and Sons, Limited, Newark-on-Trent, for a three-row ridging plough. In this machine new and improved methods are employed for steering, setting the working depth, and raising the plough bodies from the ground. It has also a neat and simple means of mounting the wheels on the ridging bodies whereby the expanding axle is rendered unnecessary.

A conspicuous exhibit on the stand of Dennis Brothers, Limited, of Guildford, was a hand-drawn motor fire-engine, of which we give an illustration in Fig. 26. In this appliance a four-cylinder petrol engine with cylinders 80 mm. bore by 130 mm. stroke drives direct a multi-stage turbine pump, which is capable of delivering from 150 gallons of water per minute at 135 lb. pressure to 350 gallons per minute at 60 lb. pressure. The engine is cooled by a circulating pump, and additional cooling can be provided by means of a by-pass from the main pump. The engine and pump are mounted on a self-contained framework, and are detachable as a complete unit from the frame of the vehicle. Air pumps are provided in duplicate for use in starting in order to create the necessary vacuum to charge the pump. Messrs. Dennis are also the makers of a 200-gallon turbine pumping unit which can be fitted to any suitable make of motor car, the total weight being 90 lb.

The "spading" harrow manufactured by James and Fredk. Howard, Limited, Bedford, and exhibited for the first time at this Show, has been designed on the principle of the ordinary disc harrow and is especially suitable for working in the heaviest soils. The forged steel spades are S-shaped and are mounted in sets of three, each group of six spades forming one disc, and the discs are set out at 6in. centres. These spades, as they revolve, lift and turn the soil, and in suitable conditions the makers claim that they will dig 4in. to 6in. deep. When working in heavy and lumpy clay soil the spading harrow cuts and moves the soil sideways, thereby pulverising and aerating it. The harrow exhibited was 6ft. wide, but these implements can be supplied wider or narrower as required.

It was the object of W. H. Allen, Sons and Co., Limited, Bedford, to make their exhibit at Cambridge as representative as possible, and with this purpose the firm showed single-cylinder oil engines of 15, 25, 35 and 50 brake horse-power. One of the 25 brake horse-power engines was mounted upon the same baseplate with a direct-current compound-wound multipolar dynamo, to which it was direct coupled; whilst a 15 brake horse-power oil engine was shown driving a 6in. centrifugal pump by belt. The pump was mounted above a tank, from which it drew water, and returned it at the rate of 375 tons per hour. The Allen oil engine has already been fully described in THE ENGINEER, but several important improvements have been recently introduced. We noted especially that a change in the fuel injection system has been rendered necessary by the fact that the fuels marketed by the leading companies vary considerably. The fuel pump setting has to be varied accordingly, and with that object in view the excentric which operates the fuel pump is now designed so that its position relative to the crank shaft can be readily adjusted by the customer. The method adopted by Messrs. Allen is to provide the inner excentric carrier, which is keyed to the engine crank shaft, with a series of small teeth or serrations to engage with a series of serrations in the outer excentric carrier. Adjustment is effected by drawing the outer carrier forward until the teeth are disengaged and moving it about the inner carrier, either backwards or forwards, the required number of teeth. When the teeth have been brought into mesh once more, the two carriers are locked laterally together by means of set screws. A further improvement which obviates an objection sometimes raised against engines of this type is designed to prevent any possibility of undue accumulation of oil in the crank case. For this purpose, a small non-return valve, automatic in action, is fitted so that any oil which has been used is blown out of the crank case to be filtered and strained before being used again.

The utility of the cream separator to dairy farmers is now so widely recognised that it is surprising to find the older method of hand skimming allowed to exist. There are many different makes of separator on the market, but the essential principle involved in all is the same. The separator is a centrifugal machine running at a very high velocity, and hence requires to be of good design and high-class workmanship. Separators can either be driven by hand or by power, and in most instances the dairymaid supplies the necessary energy. Watson, Laidlaw and Co., Limited, Glasgow, have been connected with this branch of engineering since 1886, and have been responsible for many improvements in detail. In the machinery as at present made by this firm, special attention is paid to the manufacture of a machine which can be thoroughly cleansed after use. For instance, in connection with the drum or bowl, the internal parts consist of a number of aluminium discs and a centre piece of tinned gun-metal, the whole being light, strong and non-rustable. All the discs are exactly

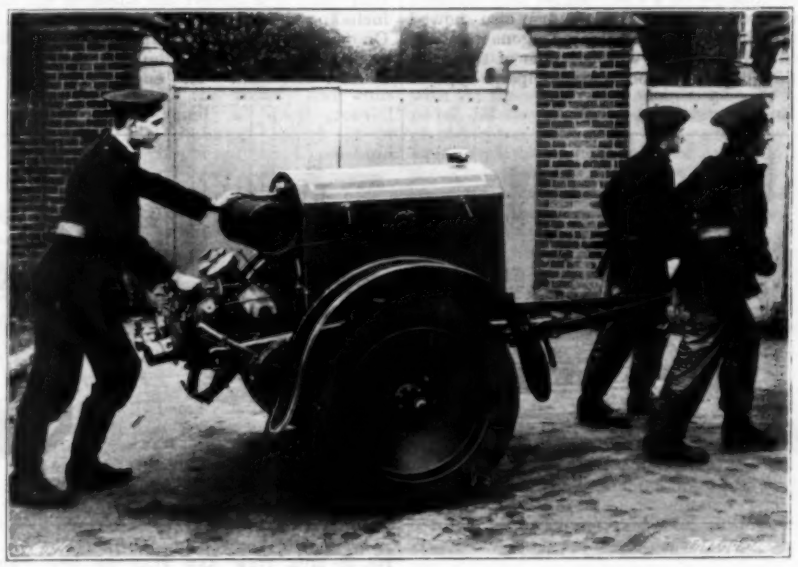


FIG. 26—DENNIS HAND-DRAWN MOTOR FIRE-ENGINE

* No. II. appeared July 14th.

alike and interchangeable, and the bowl is detachable from the spindle, although it cannot leave the spindle while in motion nor can the parts be assembled in the wrong order.

In connection with the heavier agricultural machinery, the exhibits of Wm. Foster and Co., Limited, Lincoln, were worthy of special note. A 7 horse-power single-cylinder traction engine was shown in conjunction with a 4ft. 6in. large-size thrashing and finishing machine fitted with a chaff bagger and mounted on wooden travelling wheels. This firm also showed one of its standard type 5-ton steam wagons mounted on rubber-tired travelling wheels. One of the principal features of this wagon is the Belpaire type of fire-box to the boiler, which is designed for a working pressure of 200 lb. per square inch. The engine is of the compound type, with cylinders 4in. and 6¾in. diameter and 7in. stroke. By means of a double pinion mounted on a squared extension of the crank shaft, two speeds of 4 and 8 miles per hour are provided for, the change being worked by one lever from the footplate. The drive is taken from the pinions on the crank shaft to large intermediate wheels, and thence by a strong roller chain to the compensating gear on the main axle. The compensating gear may be locked for travelling over loose or soft ground. The gearing is of cast steel, machine-cut throughout.

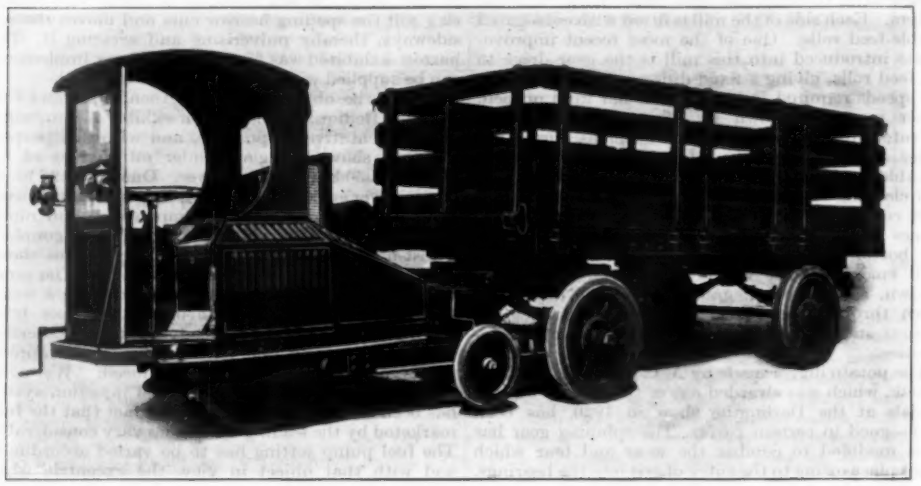


FIG. 27—THE "AUTOHORSE" ATTACHED TO A FARM WAGON

One hundred per cent. efficiency is what a large number of machine designers have been striving after for a very long time, but there are few who would venture to suggest that they had achieved their objective. S. E. Leach, Limited, Exchange-street West, Liverpool, who are the licensees for a new type of tractor shown on the stand of W. Tasker and Sons, Limited, of Andover, however, make this claim for the "Autohorse," illustrations of which are given in Figs. 27 and 28. This is a remarkable tractor in several respects, the chief of which is that its tractive effort is transmitted through a single rubber-tired road wheel, which also acts as the steering wheel. In orthodox systems the aim of the designers is to concentrate as much of the carried load as possible on the driving wheels to obtain the maximum adhesion, but in the "Autohorse" this is not the case. The "Autohorse" *draws* its load, and the exhibitors claim that it can draw many times the load that a truck of equal power can carry. It can be quickly attached to a trailer and detached while the latter is delivering its load. Although it is a single-wheel tractor, when hauling a trailer two small road wheels are provided to support the rear end when it is being driven from one job to another.

The carriage consists of a pressed steel frame, which is supported by means of springs on the axle which carries the road wheel. This frame is attached by means of the special coupling shown in Fig. 29 to the vehicle that has to be hauled. This frame also carries a large circular rack with internal teeth. The engine and gear-box are carried on an upper steel framework which has an opening in the middle, in which the road wheel can revolve. The upper frame rests on the lower one and the steering wheel operates a pinion which meshes with the circular rack on the underframe, so that when it is turned the whole of the superframe, including the engine and the driving wheel, rotates. On one side of the superframe a vertical four-cylinder engine, 95 mm. by 140 mm., is mounted in a longitudinal direction. The engine transmits its power through a clutch and gear-box and bevel gears to a transverse shaft, which in turn transmits motion to the road wheel by means of chain gearing.

The overall length of the machine is 11ft. 9in., width 5ft. 3in., height 5ft. 6in., and the weight about 2½ tons. Seats for two persons are provided. Owing to its peculiar design the "Autohorse," when alone, will turn in a circle the radius of which is somewhat less than the distance between the small rear wheels and the centre line of the driving wheel. When the machine is backed up against the vehicle to be hauled the coupling referred to above comes into operation. In the drawing the square A represents the front axle of the trailer or wagon. B is the pulling bar of the "Autohorse" when the auxiliary wheels are on the ground, and C is the same bar in its hauling position after the "Autohorse" has backed 7in. in the direction of B C. By so backing the auxiliary wheels will have been raised some 3in. to 4in. off the ground. Once past the pawl D, the latter drops back into position and the pull is taken at the point E. When it is desired to detach the tractor from the trailer the handle F is pulled in the direction G and the pawl rises, allowing C to slip down the inclined plane to B. There are two couplings to each machine.

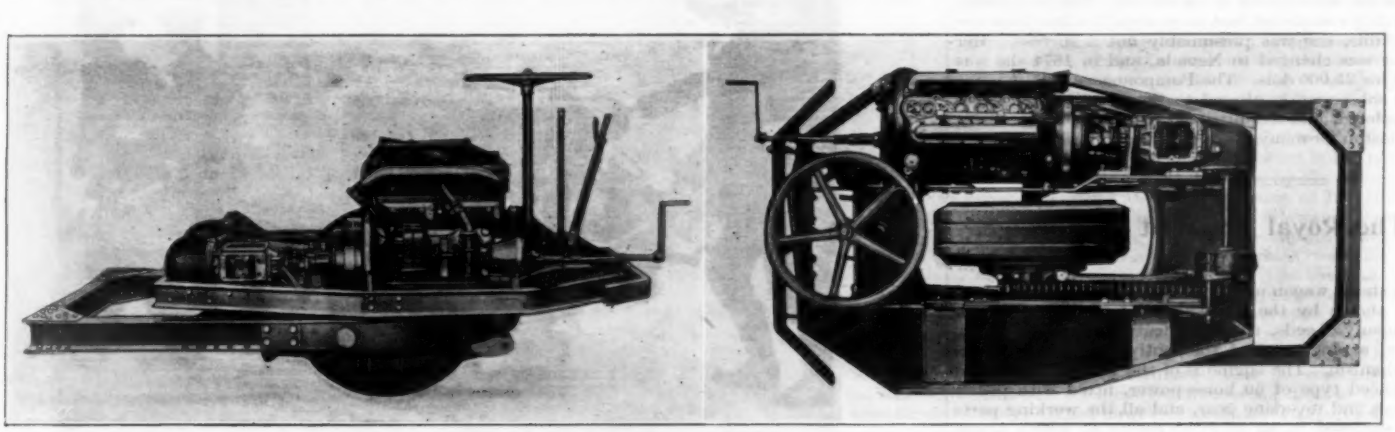


FIG. 28—SIDE VIEW AND PLAN OF THE "AUTOHORSE"

On the stand of Alfred Dugdale, Limited, Conduit-street, London, we noticed a new and ingenious attachment called the "Cutmore," mower for Fordson tractors, whereby the tractor can be converted into a self-contained motor mower with little trouble and expense. The driving mechanism of the mower is attached directly to the rear end of the tractor worm drive shaft and power for operating the knife is taken directly from this drive. The knife is therefore driven at the speed of the travelling wheels, the same as with horse mowers, and not at the engine speed. For every 5¼in. forward travel of the driving wheels the pitman which works the knife makes one complete revolution. The knife is only in operation when the tractor is in motion. The complete mechanism is easily attached to or detached from the tractor, and a simple safety device is provided to prevent breakage of knives in case of an obstacle being encountered by them. This device operates the clutch lever of the tractor and stops the latter's progress.

During recent years concrete has come into very general use for farm and estate work, and the Royal Show is usually well patronised by the makers of machinery and appliances connected with this growing branch of building construction. Goodwin, Barsby and Co., Limited, Leicester, showed a collection of machines and appliances of special interest to public bodies, quarry owners, builders and contractors. These machines included a stone-drying and tar-macadam mixing plant, driven by a paraffin engine, as well as a machine for making hollow concrete blocks. The cores of the blocks measure 4½in. by 5in., and are worked horizontally. Another firm exhibiting concrete block-making machinery was the Clyde Engineering Works, Barry Docks. The machine shown by this firm is operated by one man, and is of extremely simple and substantial construction. It comprises angle-iron standards connected to steel plates by rivets and, adapted to support it at a suitable distance from the ground or floor level, a table,

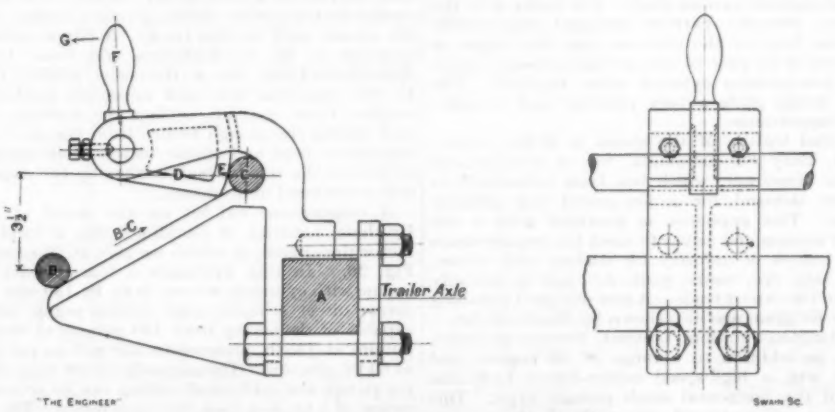


FIG. 29—COUPLING GEAR OF THE "AUTOHORSE"

whereon the mould box for the aggregate is placed. This box is formed by four angle irons, which are slightly grooved on their inner faces to receive thin division plates, which enable the operator to mould either four blocks or two, according to his requirements, at one time. The floor or bottom of the box consists of a vertically movable plate, operated by a

foot lever and suitably mounted on the framework of the machine. The box is covered by a pressure plate, which is carried by a pusher rod connected with a hand lever mounted on the top of the machine. The necessary pressure for effecting the moulding and compression of the aggregate in the box is applied by the hand lever without the expenditure of much effort.

The chief points of interest in connection with the 6-ton steam wagon shown by Leyland Motors, Limited, Leyland, are the boiler and the engine. The former is of the thimble tube type fitted with a superheated coil above the water tubes. It is designed for a working pressure of 250 lb. per square inch. The fire-box is provided with a fire-door, and the construction is such that there is no need to drop the fire-bars for cleaning purposes. The engine has two high-pressure cylinders, each 4½in. bore and 6in. stroke, and the valves are of the poppet type, thus giving a very quick cut-off. A two-speed gear is provided, and a water pump for use when the wagon is stationary is fitted. All the shafts run in Timken roller bearings, and the differential being enclosed in the engine casing always runs in oil. The springs are of the semi-elliptic type of considerable length so as to give easy running, and the water tank has a capacity of 154 gallons.

The name of Petter is always associated with the hot-bulb engine, and, as usual, the firm of Petters, Limited, was represented at Cambridge by numerous examples of its well-known products, amongst which special attention should be called to the new 5 and 8 brake horse-power engines, designed for use with crude or refined oil. The working principle of these engines is identical with that of the larger sizes. The general design follows closely that of the Petter Junior series, except that the fuel is supplied by means of a pump operated by an excentrically mounted cam controlled by the governor. Starting is effected by means of an improved lamp, and no self-starter is necessary, as the engines can easily be turned by hand. These engines are also made in the semi-portable and portable types.

Sir W. G. Armstrong, Whitworth and Co., Limited, showed electric lighting sets in which the power is supplied by four-cycle vertical type engines, designed to work on either paraffin, petrol or gas. When using paraffin a special vaporiser is incorporated, which introduces exhaust gas into the combustion chamber, and the makers claim that by this means the knocking which is commonly experienced with paraffin engines is obviated. The semi-automatic lighting set shown by this firm is designed to give the best charging conditions for batteries. The engine can be run for driving pumping or other machinery with the electrical apparatus cut out, or the set can be run direct on the electric circuit without the intervention of a battery, whilst starting up is effected by a simple movement of the switch. All these functions can be performed by a single handle on the switchboard. Automatic signals are arranged, both on the switchboard and in the building which is lighted, indicating when the battery requires replenishing. These signals operate on a voltage relay. The dynamo was made by Cromptons. Messrs. Armstrong showed also engines operating pumping and other machinery from 3 up to 16 brake horse-power. Lubrication of these engines is automatic, by means of a plunger pump which delivers the lubricant to channels leading to all the main bearings.

Another firm that has recently come into prominence in connection with the small oil engine industry, viz., Bamfords, Limited, of Uttoxeter, showed engines of the smaller sizes of similar design to that which won the Society's Silver Medal at Darlington two years ago. These engines are of the horizontal four-stroke variety, and the valve arrangement is such as to give ease of access to the cylinder and piston. They are made in sizes varying from 2½ to 6 horse-power, and the ignition of the charge is accomplished by an oscillating magneto. On the stand at Cambridge was shown a 2½ horse-power engine driving a shunt-wound dynamo of 750 watts capacity, which charged a 50-volt battery of 120 ampère hours capacity. This particular set includes a switchboard for regulating and distributing the current.

Clayton and Shuttleworth, Limited, Lincoln, had a representative display of exhibits comprising a 6 nominal horse-power steam traction engine, a 5-ton steam wagon, horizontal and vertical valveless crude oil engines, a finishing thrashing machine, a light tractor thrashing machine and a steam power-driven chaff cutter. The principal points in connection with the traction engine are the Belpaire boiler, with its efficient method of supporting the crown plate of the fire-box and the obviation of roof bars; the method of attaching the engine to the boiler through the medium of hydraulically pressed mild steel seatings, which are riveted to the boiler; the crank shaft and first motion shaft bearings cast in one bracket; and the gear-driven feed pump, which is placed in the driver's tender. The motion of the engine is transmitted through a train of gears to the road wheels, and two travelling speeds are provided. The change wheels slide on square sections of the first motion shaft, and are so arranged that under no circumstances can any interlocking take place. When either of the change wheels is in gear, the crank shaft power is transmitted to the second motion shaft, and thence through the main driving pinion and spur wheel to the hind axle. The motion shafts and axles are of mild steel and run in gun-metal bearings, provided with ring lubrication. The Clayton steam wagon is familiar to all interested in heavy motor traction. The machine shown is fitted with an end-tipping body, arranged to be operated through a clutch and side shaft from the engine—a quicker process than hand operation. The valveless oil engine made by this firm has been on the market some years. It is specially designed to operate either on heavy fuels or refined petroleum oils. It is a two-cycle engine, in the design of which the makers have combined sound construction and easy access. By unscrewing five nuts, the crank case cover can be removed, and the crank shaft and connecting-rod end exposed. Starting is effected by means of a paraffin blow-lamp. The tractor thrashing machine is inexpensive, and while embodying all the features of the ordinary finishing thrashing machines built by this firm, can be operated by an engine giving from 15 to 18 brake horse-power. It weighs 3 tons, and the height to the top of the platform is 7ft. 6in.

The Crawley Agrimotor Company, Limited, Saffron Walden, showed a cheap and simple apparatus called the "hydrohoist" for raising water from wells, ponds, &c. It is illustrated in Fig. 30, and is a modification of the chain pump, which has recently come again into prominence, but with this important difference, that it does not rely entirely on capillary attraction for its operation. The hydrohoist consists essentially of an endless tinned wire rope, on to which are threaded pressed steel cups, passing over a grooved pulley fixed in a collecting tank. The lower bend of the cup rope is immersed in the water, and runs round a deep-grooved "diabolo," which keeps the cup rope taut and prevents it from twisting. If the shaft is turned fast, the water is thrown out of the cups by centrifugal force when passing over the top pulley, and if it is turned slowly it runs out through the special grooved pulley. In either case, it is caught in a collector, and flows out at the delivery spout. The water being raised, not only fills the cups, but also, if the speed is high enough, the space between the top of the cup sides and the bottom of the next cup above; but apart from this, when the cup rope is moving fast a large amount of water is carried up, clinging to the outsides of the cups by capillary attraction. The hydrohoist was shown operated manually and by power. One example of a power-driven water lifter is said to be capable of lifting 1000 gallons of water per hour from a depth of 200ft., and it is fitted with a force pump to raise the water a further 75ft. The hand-operated device has a capacity of 900 gallons per hour.

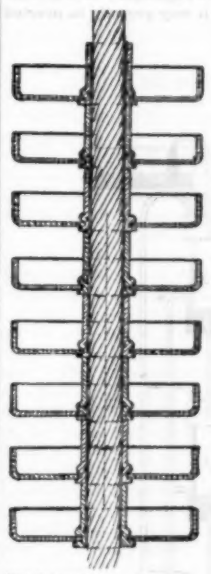


FIG. 30—THE HYDROHOIST

On the stand of E. H. Bentall and Co., Limited, Heybridge, Maldon, was to be seen a new elevator for fitting to this firm's power-driven root-cutting machines. It consists of an oscillating chute placed under the machine, which delivers the cut roots into the boot of the elevator. The latter is of the usual pattern, with its elevating web consisting of malleable chains and wooden slats. In the Gardner turnip cutter the usual frame and wooden chute are replaced by an iron casting, which forms the chute and the means of attachment of the legs to the machine.

Richard Garrett and Sons, Limited, Leiston, exhibited a steam traction engine, a steam tractor, a steam road roller and a 6-ton undertype superheated steam motor wagon similar to that which was illustrated in THE ENGINEER on April 7th last. A special feature in the purely agricultural machines shown is the 54in. farmers' type thrashing machine, which has been specially designed by the makers for the use of farmers who can do their own thrashing, and can be operated in connection with a small petrol tractor. The machine is fitted with chaff-bagging apparatus and ball bearings to all fast-running spindles.

A second silver medal was awarded to Mr. G. W. Watson for his draw-bar dynamometer, which was specially designed for making tests of tractors. The instrument records on a roll of paper the distance travelled, the time occupied, the speed, the magnitude of the pull exerted by the tractor on the plough or other implement which it draws, and the average depth to which the plough is cutting, this being the average of all furrows cut, and not the depth of one furrow only. Briefly, the instrument consists of a frame which carries a cylinder, filled with oil, in which a piston fits. The pull exerted by the tractor causes the oil to be put under a pressure proportional to the pull, and the pressure of the oil is made to operate a moving pen or stylus, and this records the variations of pull on a roll of paper. Similarly, there are two other pens, one of which records the time, and the other the depth of ploughing. The roll of paper is driven round the drum at a speed directly proportional to the rate of travel, and the drum is driven through a flexible shaft from a trailing wheel of definite circumference. There are levers fore and aft of the instrument for attaching to the tractor and plough respectively, each lever being provided with two holes. When the tractor and plough are connected to the lever of these two holes, the instrument will record pulls up to 3000 lb., but for tests in excess of 3000 lb. and up to 6000 lb. the connections are made to the upper of the two holes.

John Fowler and Co. (Leeds), Limited, had on view cable ploughing engines operated by both steam and paraffin, but the recent labour troubles in the engineering trade prevented the exhibition of the new implements, which had to be replaced by some that have already been in service. They had entered for the Society's silver medals a strong four-furrow subsoil balance plough. This plough cuts and subsoils four furrows in each direction, turning the land all one way, and leaving no open furrows. Subsoil tynes and points follow each share, so that the furrow sole or "pan" is broken, and the bottom opened for aeration and drainage without bringing the subsoil to the surface. Provision is made for the adjustment of depths and the subsoiling tools can be adjusted independently of the plough shares. The chief feature of the plough is a new arrangement of the subsoil tynes, which allows the furrow wheel to travel on a solid bottom in advance of the leading subsoil tyne, thereby eliminating the consolidation of the soil, which has hitherto taken place by the furrow wheel following the tyne and travelling on a previously disturbed furrow bottom. In Fowlers' 60–70 horse-power cable ploughing internal combustion engine, the starting of the main four-cylinder engine is accomplished by means of a single-cylinder air-cooled engine connected to a shaft which carries friction discs. These discs are brought into contact with the fly-wheel of the main engine, by means of a pedal. Messrs. Fowler are still very ardent advocates of the steam engine for this class of work, where cheap fuel and good water are available, but when these essentials are difficult to obtain they have for some time recognised that the internal combustion engine has its advantages and the engine shown has done excellent service in Norfolk.

Another new machine shown for the first time at Cambridge was a tamping machine made by Messrs. B. Johnson and Son, Bramley, Leeds. This is a portable machine in which a tup is lifted periodically by means of suitable mechanism and a small paraffin engine, the whole of which is carried on a pivoted frame, so that it can be swung through a radius of several feet. Although the tup is lifted by power, it falls by gravity, and as many as fifty blows per minute can be given with a height of drop of 24in. The dropping weight is 175 lb. and the horse-power of the engine 2½. The machine is specially adapted for tamping trenches or breaking up macadam roads in advance of excavation.

Messrs. Blackstone and Co., Stamford, had an extensive display of oil engines and agricultural implements. The oil engines included one of 22 and one of 24 brake horse-power, the latter driving a dynamo. These engines are designed for operating on crude oil, and are of the Diesel type, with the fuel injected at the end of the compression stroke, but without relying for ignition upon the heat of the air compressed in the combustion chamber. Two fuel sprays are used, the fuel injected in the main spray being ignited by the flame produced by the explosion of fuel injected by an auxiliary spraying valve into a chamber containing an incandescent member. This chamber is heated at starting by means of a lamp, but when running is maintained at the correct temperature by the combustion of the fuel. The constant charge of oil is delivered to the auxiliary spray, and any quantity in excess of the correct amount overflows in the main spray, the volume of the latter being regulated by the action of the governor on the fuel pump. The compression in the cylinder is in the neighbourhood of 150 lb. per square inch, and the pressure of the injected air 450 lb. per square inch. The prolongation of the fuel injection period is maintained by an oil reservoir in connection with the main spraying valve, and so constructed that it is not immediately emptied when the main spraying valve is open, a further supply being forced into the cylinder after the piston has commenced its outward stroke. Another type of engine using paraffin was shown in three sizes, viz., 8, 22 and 5.8 brake horse-power. In this engine, paraffin is sprayed into the combustion chamber at the end of the compression stroke, and a portion of the spray is directed into an electric spark gap, where it becomes ignited. Compressed air for spraying the fuel is supplied by a compressor worked from the engine crank shaft, and a reservoir or container charged by this compressor enables the engine to be started from cold by operating a hand lever. Messrs. Blackstone exhibited a tractor and a locomotive, each of which is operated by a three-cylinder engine which starts from cold. The engine in each case is capable of generating 25 brake horse-power at 700 revolutions per minute.

There was about the usual number of steam wagon

exhibits, the most novel of which was that of Messrs. Atkinson and Co., of Preston. This wagon has a capacity of 4 tons, and is propelled by a uniflow engine. In this type of engine there are of course no exhaust valves, and the admission valves consist of steel balls. There is only one cam shaft, the valves for the two ends of the cylinders being actuated from a common shaft and cam. This shaft is driven by spur gearing from the crank shaft, and the engine is controlled by moving the cam shaft endwise, three points of cut-off being thus furnished. A neutral cam is provided to open the valves for warming up purposes. To relieve the compression in the cylinders, large relief valves are fitted in the cylinders. The working pressure of the boiler is 230 lb. The transmission system is simple, power being transmitted to the rear axle by means of a chain and differential gear.

Another firm which exhibited steam wagons was Fodens, Limited, Sandbach. This firm showed its latest pattern 6-ton rubber-tired wagon fitted with Ackerman steering gear. The boiler is of the horizontal multitubular locomotive pattern designed for a pressure of 220 lb. per square inch, the effective heating surface being 90 square feet. The engine is mounted on the top of the boiler as usual, and is of the compound type. The cylinders are steam jacketed, and 4½in. and 7in. diameter by 7in. stroke. The transmission system provides for three speeds, viz., 4, 8 and 12 miles an hour. A pitch roller driving chain transmits power from the stud shaft to differential gear of the bevelled wheel type on the back axle. The road wheels are of cast steel, and the brakes operate on the rims. The water tank is of sufficient capacity to take the wagon loaded with 6 tons a distance of over 30 miles on good roads.

Mann's Steam Cart and Wagon Company, Limited, Leeds, showed four vehicles of its standard design. The tractors are specially designed for road haulage, and are constructed to comply with the Motor Cars Act. They are built on the four-shaft inside gear principle, and have no gear wheels outside the bearings on the overhanging ends of the crank and intermediate shafts. The engine is mounted on long laminated springs, which are outside the horn-plates. The differential gear can be locked by a hand lever from the foot-plate of the engine. The steerage is of the worm and quadrant type, as on the firm's steam wagons, consequently there are no chains to break or slackness to take up. The winding drum is loose, so that the wire rope can be paid out while the engine is running forward. Governors are fitted where required for driving a thrashing machine, saw bench, stonebreaker, &c., from the fly-wheel. The steam cart is specially designed for use in confined places, and has therefore a short wheel base. Being compact, it is driven throughout by spur gearing, whereas the steam wagon has a roller chain of the final transmission from the third motion shaft of the engine to the main axle. A 5-ton tipping wagon shown by this firm had an interchangeable water tank. The tipping body and the water tank are interchangeable, so that the wagon may be used either for hauling road metals or other purposes. This wagon is fitted with a centrifugal pump for quickly filling a 1000-gallon tank.

Aveling and Porter, Limited, of Rochester, showed amongst other machines a 10-ton compound steam roller, with piston valve steam engine, renewable tired roller wheels and Price's scarifier; a quick-reverse kind of roller for bituminous and asphalt work and the colonial type tractor converted to a steam roller 10 tons weight. The quick-reverse steam roller consists of a strongly built frame channel section carrying the driving and steering rollers. The boiler and engine are carried rigidly on the main frame between the rollers. The boiler is of the vertical fire-tube type, and the engine of the horizontal double high-pressure type, with cylinders side by side fitted with piston valves. The weight of the machine normally is about 5¾ tons, but a tray is provided for carrying up to 15 cwt. of tar-macadam, and the total weight may be increased to 7 tons by the substitution of cast iron roller wheels for built-up steel wheels. The wheel base is 9ft. 5in., the rolling width 4ft. and a turning radius 17ft.

MINERS are going after gold on the bed of the Upper Fraser River in diving suits, according to *Canada*. Two gangs of deep sea miners already are at work at Lillooet and at the confluence of the Chilcotin and Fraser rivers. Each shift, working a three-hour day in all, is said to be getting from 700 to 1000 dollars a day. The use of the aeroplane in prospecting on mountain claims has also been tried with success.

REMARKABLE results have been achieved in the speeding up of the grain-handling facilities at the French ports which have been equipped with Simon plants, and this is demonstrated by the fact that a ship which had previously taken ten days to unload was afterwards discharged in three days. At Le Havre, where two plants were installed, the specified capacity was 75 tons per hour for each plant, but the test cargo of 6900 tons of oats was discharged, sacked-off and delivered to stacks in three days at the average rate of 83.1 tons per hour for each plant. This working time included all stoppages for moving from hold to hold, &c. As the oats were in 100 lb. sacks, it will be seen that the output represented an average of thirty-one sacks per plant per minute, or a total of one sack per second for the two plants. This capacity, the makers claim, stands unrivalled by any other sack-handling plant in the world.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

WATER RAISING.

SIR,—Water raising is one of the oldest occupations of the engineer, and it is not surprising that new ways of doing it are difficult to find. The Pulsometer is, of course, only a modified Savery engine, and the chain-helice and others of the same kind had their predecessors in the hair-rope pump and similar devices. Now comes the Hydrautomat, which you illustrated in your last issue. The system is more than a hundred years old, as you may see from the enclosed drawing taken from "Gregory's Mechanics" of 1825. There are differences, but the principle—based on Hero's fountain—remains the same. The drawing shows also another pumping device, which has been recently revived in a very neat form—the old Chain-of-Pots. I saw a water raiser built on this plan working in a Paris shop some twelve months ago. The "pots" were little metal troughs formed integrally with the links of the chain and all quite close together.

I append a Gregory's description of the old water raiser in case you may care to reproduce it. N. S.

July 10th.

7. A machine designed to raise water to a great height for the irrigation of land, in such situations as have the advantage of a small fall, is described in Dr. Darwin's *Phytologia:* as it depends on the principle of Hero's fountain, it may properly be inserted here.

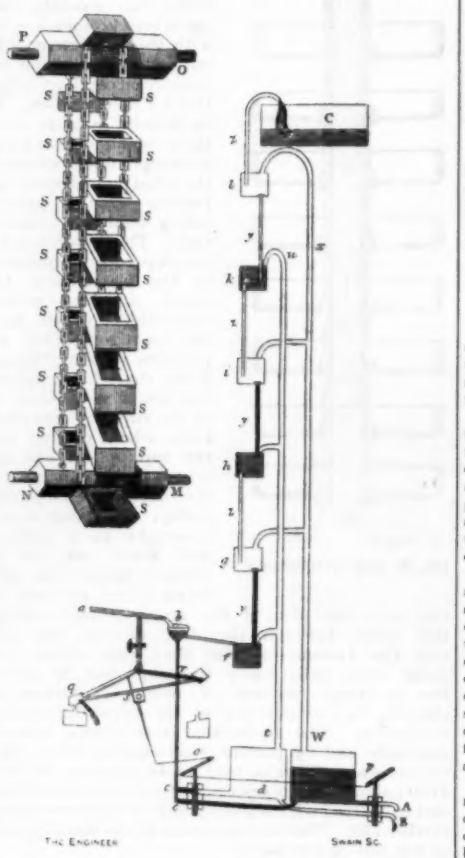


Fig. 4 pl XIX. *a*, *b*, is the stream of water.

b, *c*, *e*, represents the water-fall, supposed to be 10 feet.

d, *e*, are two leaden or iron vessels, containing a certain quantity of water, which may be computed to be about 4 gallons each.

f, *g*, *h*, *i*, *k*, *l*, are leaden vessels, each holding about two quarts.

o, *p*, two cocks, each of which passes through two pipes, opening the one and closing the other.

q, *r*, is a *water-balance*, that moves on its centre *s*; and by which the two cocks *o* and *p* are alternately turned.

t, *u*, and *w*, *x*, are two air pipes of lead, both internally one inch and a quarter in diameter.

y, *z*; *y*, *z*; *y*, *z*; are water-pipes, each being one inch in diameter.

The pipe *b*, *e*, *c*, is always full from the stream *a*, *b*; the small cisterns *g*, *i*, *l*, and the large one *d*, are supposed to have been previously filled with water. The fluid may then be admitted by turning the cock *o*, through the pipe *c*, *e*, into the large cistern *e*. This water will press the air confined in the cistern *e*, up the air-pipe *w*, *x*, and will force the fluid out of the cisterns *g*, *i*, *l*, into those marked *h*, *k*, and *c*. At the same time, by opening B, the water and condensed air, which previously existed in the large cistern *d*, and in the smaller ones marked *f*, *h*, *k*, will be discharged at B. After a short time, the water-balance, *q*, *r*, *s*, will turn the cocks, and exclude the water, while it opens the opposite ones: the cisterns *f*, *h*, *k*, are emptied in their turns by the condensed air from the cistern *d*, as the water progressively enters the latter from the pipe *b*, *c*.

ELECTRIC COOKING.

SIR,—In your account of the annual convention of the Incorporated Municipal Electrical Association you make certain references to electric cooking, the net effect of which is, I feel, not quite just to the present stage of development. "Criticism of electric cooking apparatus is," you remark, "by no means silenced." I would like to point out, first, that only one speaker at the convention alleged that modern electric cooking apparatus was unsatisfactory, and his observations were clearly at variance with the general opinion. Secondly, although your statement is literally true, the same statement can be made with equal justification about any sort of appliance. Criticism of motor cars, locomotives, or anything else in the whole range of engineering is not yet silenced, and never will be.

I consider it only fair to the British makers of electric cooking apparatus to recognise that they have now overcome the numerous difficulties involved in giving a satisfactory combination of structure, element, and connections in electric cooking apparatus. There is ample evidence—to which I add my own personal experience—that the latest types of electric cooking appliance give remarkably little trouble, if any.

London, W.C. 1, July 12th. ADAM GOWANS WHYTE.

THE EXPENSES OF APPLICANTS.

SIR,—I should be pleased to see an expression of opinion upon the question of paying expenses to an applicant when asked to attend for an interview.

I recently answered an advertisement for a position as general manager, and received a reply asking if I was in a position to invest capital, subject to the business being satisfactory, although no mention of capital appeared in the advertisement. This appeared quite reasonable, since I did not wish to hold a responsible position with a company without having an interest in the business, and I replied that I might be able to make an investment, but that I did not wish to secure the position except through qualifications and experience alone. To this letter I received a telegram asking me to call and see them, confirmed by letter stating that personal qualifications were essential, and that it was impossible for them to engage the services of an incompetent man who might squander any capital he might put up.

Imagine therefore my surprise on attending for an interview to find that it was solely a question of finance which had to be discussed, and that the position of general manager had already been filled.

I had paid an expensive railway fare to see them, together with incidental expenses, so that under these circumstances I felt fully entitled to some recompense. The principal, however, said he had never heard of expenses being paid, and although I have sent in a claim I have so far received no reply.

I have often interviewed applicants myself, and in no case have I ever failed to pay their expenses in coming to see me, even where they have secured the position, a custom which I had understood to be practically universal.

An expression of opinion on this question, if otherwise, would no doubt be of interest to many readers at the present time.

July 17th. APPLICANT.

GAS FROM SEWAGE FILTERS.

SIR,—One day last week an assistant of mine, who was examining the alternating gear of a contact bed installation in the West of England was attacked, and rendered nearly unconscious, by gas. The works manager then informed him that the same thing had happened to him.

In all my previous experience of sewage filters, extending over twenty-six years, I have never heard of a case of the kind, though the risk of explosion of tank gas is well known. It is evident, however, that filter gas may also, in certain circumstances, be a source of danger, and this danger is not, I think, generally recognised. I shall be glad, therefore, if you will allow me, through the medium of your widely read columns, to bring the matter to the notice of engineers and others having charge of sewage works.

As to the origin of the gas there is, of course, no mystery. A sewage filter in the course of a day oxidises a considerable amount of carbon, producing thereby a corresponding volume of carbonic acid gas. This gas, being heavier than air, sinks to the bottom of the filter, and passes off through the underdrains. Where the latter have a free outlet, the CO_2 will flow off with the effluent as fast as it is produced; but where the drains converge in a central chamber, the outlet from which is submerged or otherwise trapped—in the case in question the discharge pipe is provided with a reflux valve to protect the filters from flooding—the gas may be unable to escape, and will accumulate in the lower part of the chamber.

Although CO_2 is not actually poisonous, it will not support respiration; and if present in sufficient quantities may cause death by suffocation. Those who have occasion to work in chambers in which this gas is liable to collect should therefore be warned not to stoop down in them without first testing the air in the bottom of the chamber by means of a light.

ARTHUR J. MARTIN.

London, July 17th.

[We suggest that on the whole it might be wiser to drive the gases out by waving a cloth or fan than test them with a naked light, as there is a bare possibility that an explosive mixture might exist.—ED. THE E.]

VANE WHEEL PROPELLERS.

SIR,—I find the impression has gone abroad that our most recent advance in propellers is intended solely for shallow draught. It is true we started with the idea of fitting it to vessels like stern wheelers with very shallow draught, but the actual vessel on which we tried it on the Clyde was not a very shallow draught one, and we see no reason meantime why it should not be applied at any draught. What I actually said at the Paris meeting of the Institution of Naval Architects in connection with the vane wheel was as follows:—"I may say that a very similar arrangement was invented, made, and tried by one of the Napiers—David, I think—but it was a failure."

ARCHIBALD DENNY.

Wimbledon, July 19th.

AT the Lochore colliery of the Fife Coal Company, a new shaft 20ft. in diameter is being sunk to a depth of 290 fathoms. The method adopted is to sink 90ft. to 100ft. at a time, temporarily supporting the sides with skeleton rings, &c., and then to put in a lining of concrete 18in. to 2ft. thick, starting from the bottom and proceeding upwards. Sheet iron tubbing is put in to retain the concrete until it has set. The segments are ½in. thick, 2ft. 6in. high, and eight to the circle. They are flanged to the inside for the purpose of bolting together. One hundred feet of the shaft can be lined in this manner in about four days. Time is allowed for the concrete to set, and the retaining tubbing is then taken out and removed to the surface to be cleaned and made ready for the next length of walling.

A Seven-Day Journal.

The T.S. Victorian.

THE Canadian Pacific Ocean Services' turbine steamer Victorian, a vessel of 10,640 gross tons, built for the Allan Line by Workman, Clark in 1904, has had her turbines renewed and been fitted with single reduction gearing by the Fairfield Company. After the overhaul she made a speed of 16.21 knots on the measured mile and maintained a mean speed of 15.86 knots on a prolonged trial with a fuel consumption equivalent to 115 tons per twenty-four hours. Before the conversion the Victorian had, we understand, a service speed of about 13 knots.

The Industrial Development of Woolwich.

As has been previously noted in this Journal, a scheme is now being promulgated and discussed under which it is sought to increase the industrial prosperity of Woolwich by inducing the Government to give up some of the valuable land and river frontage at present covered by the Arsenal and Dockyard. This scheme has received considerable support and is being brought before a committee now sitting to decide the future of the Arsenal. The land which it is urged should be set free includes a large portion of that taken over by the Government since 1914, and would be used for the development of private industries. It is also urged that the Royal Dockyard should similarly be given up. It is rumoured that the Government has already decided to remove the whole of the Army Ordnance Department from Woolwich to another establishment, possibly to Didcot, on the Great Western main line.

Shipbuilding in the Strand.

IT must be many years, if not centuries, since any shipbuilding was done in the Strand, London, for in spite of the nautical origin of its name, the well-known highway is now separated from the Thames by a broad strip of land whereon are situated many notable buildings, including, of course, the office of THE ENGINEER. At the present moment, however, shipwrights—or are they only carpenters?—are at work on the erection of a ship, or, to be quite precise, the full-sized model of a section of a ship, on a grass plot adjoining the Royal Courts of Justice. The model is being constructed in connection with a case being brought by the Federal Steam Navigation Company, Limited, against R. and H. Green and Silley Weir, Limited, for damage alleged to have been caused to the steamship Shropshire as a result of a fire which took place while the vessel was undergoing repairs in the defendants' yard at Falmouth.

A New Motor Fuel.

AT the annual meeting of the Distillers' Company, Limited, the chairman announced that the experiments which the company had been carrying out during the past two years on the production of a new motor fuel had yielded highly satisfactory results, and that a mixing plant had been erected at the Hammersmith distillery, from which the new fuel was being supplied regularly to a limited number of customers. It is understood that the new fuel is produced by mixing crude whiskey with an extract from a vegetable of Indian origin, and that it can be sold at a price equal to about half that at present charged for petrol. Additional mixing plants are to be erected at Liverpool and Glasgow.

High Shipbuilding Costs.

THE new Aberdeen liner Diogenes, a twin-screw turbine vessel of 12,300 tons, built by Harland and Wolff for George Thompson and Co.'s Australian service, has cost about three times as much as would have been required to build her in pre-war days. For that reason she is regarded by her managers, even before she sets out on her first voyage, as a doubtful investment. According to Mr. H. A. Sanderson, Messrs. Thompson were obliged to build the vessel in the interests of their business, although the cost involved was such that they could not hope to receive in return more than a modest rate of interest and depreciation. The vessel is equipped to carry 132 first-class and 422 third-class passengers, together with cargo and frozen produce. The propelling machinery consists of Brown-Curtis compound turbines driving through double reduction gearing.

The British Empire Exhibition.

SINCE the first turf was cut by the Duke of York in January the works for the British Empire Exhibition to be held at Wembley Park in 1924 have made rapid progress. The Stadium, to accommodate 125,000 people, is to be ready for use by April, 1923. The contractors, Sir Robert McAlpine and Sons, having completed the 600 odd foundation pillars, are now engaged upon the stands and the terrace steps. A feature of the Stadium will be a roadway 70ft. wide completely encircling the arena and covered by the terracing. Near the Wembley Park Station entrance to the exhibition the foundations are being laid for two large buildings having a total floor area of about 20 acres, in one of which British machinery and other engineering products will be shown, and in the other general industrial exhibits from the United Kingdom. India, Australia and South Africa between them are expending £410,000 on buildings to house their exhibits, and Canada and New Zealand, it is expected, will co-operate on similar lines. On Thursday of last week the British Engineers' Association, accompanied by representatives of many well-known engineering and allied firms, paid a visit of inspection to the site. As we have already intimated in these columns, the Association has been entrusted with the organisation and allocation of space in the shipbuilding, marine, mechanical and general engineering section of the exhibition. Provisional applications for space are now being invited by the Association's secretary, 32, Victoria-street, S.W. 1.

An Anti-corrosion Association.

SIR ROBERT HADFIELD recently estimated that the ravages of rust and corrosion represent a wastage having an annual value of more than £500,000,000. Without troubling to criticise this figure, all will agree that the loss is certainly very great, and that it is well worth while preventing by every practicable means. It is therefore with great interest that we note a proposal to found an Association of Manufacturers of Non-corrodible and Anti-corrosive Products, and that certain well-known firms making stainless steel, acid-resisting chemical plant, anti-corrosive paints, boiler preservatives, &c., have already intimated that they are in accord with the formation of such an association. The scheme has been initiated by Mr. W. R. Douglas Shaw, the secretary of the Institution of Aeronautical Engineers, to whom communications on the subject should be addressed, care of the Royal Society of Arts, 18, John-street, Adelphi, W.C. 2. It is proposed that the Association should act as an Institution of Anti-corrosion Engineers and also as a Chamber of Commerce for firms making any material or appliance connected with the prevention of corrosion. It is suggested that a public exhibition of non-corrodible and anti-corrosive products should be held in London at an early date.

The Royal Engineers' War Record.

ON Wednesday, the Duke of Connaught unveiled the Royal Engineers' war memorial at Brompton Barracks, Chatham. In the course of his remarks his Royal Highness stated that at the outbreak of the war the corps consisted of 1833 officers and 24,172 men. On Armistice Day it consisted of 17,711 officers and 300,222 other ranks. The casualties, killed and died, amounted to 1066 officers and 18,589 men. Sixteen Victoria Crosses were awarded to members of the corps in addition to 484 Distinguished Service Orders, 2001 Military Crosses, and a large number of other decorations.

A Cornish Ocean Dock Scheme.

THE St. Just, Falmouth, ocean dock scheme, for which parliamentary approval was obtained in 1919, would appear to possess a fair chance of being carried out, partially at least, at an early date, for a syndicate has now been formed to secure the necessary capital. The execution of this scheme would, it is believed, be of great national importance, for it would provide an additional port on the South Coast for Transatlantic and other liners. With its natural deep-water approach, small tidal range, and gentle currents, St. Just, opposite Falmouth, is claimed to have an ideal situation for an ocean dock to accommodate the largest vessels in existence. By making use of it instead of Southampton Transatlantic liners, it is estimated, could perform an extra round trip per year. The first stage of the proposed works would consist of constructing a quay 3700ft. in length, together with railway connections, fuel depôts, &c. Tidal basins and graving docks would be undertaken at a later date. The scheme is in the hands of the St. Just (Falmouth) Ocean Wharves and Railway Company, to which company Sir Henry Japp is acting as consulting engineer.

Railway Shopmen's Wages.

THE Industrial Court has issued its decision in the arbitration proceedings regarding the rates of pay and conditions of service of English and Welsh railway shopmen. Certain of the men's unions, including the National Union of Railwaymen, claimed that the rates of pay of railway shopmen should be fixed without necessary reference to district rates recognised by other employers. Others of the unions urged that the companies should pay the district rates. The railway companies, parties to the proceedings—the principal companies, with the exception of the Great Central and Great Northern—were prepared to grant the district rates to fitters and to some extent to labourers. The rates for other skilled workers were to be determined by reference to the fitters' rate, and those for semi-skilled and unskilled workers by reference to the labourers' rate. The Court held that, although it was proper to regard the railway service as an industry by itself, it would be impossible to grant rates of wages to railway shopmen widely different from those fixed for similar labour in other industries. The Court therefore has suggested rates of wages which vary according to craft and district. The new rates are to come into effect on October 1st. The Court has also proposed that in all railway workshops, running sheds and depôts the standard day, intermediate, or night-shift week shall be of forty-seven hours, with a minimum period of rest of eight hours between shifts.

The Empire Airship Scheme.

THE Government's attitude towards Commander Burney's scheme for the establishment of an airship service between Great Britain, India and Australia is not made much clearer by Mr. Lloyd George's statement in the House of Commons on Monday. He began by stating that in view of the need for economy it had been decided that no money should be expended on the development of an airship service either for commercial purposes or with the object of establishing Imperial communications. In view of this definite statement it might be thought that Commander Burney's scheme, involving as it does considerable financial assistance from the Government, had been finally rejected. Such is, however, apparently not the case, for Mr. Lloyd George immediately went on to say that a special committee was being appointed to consider whether the Burney scheme were technically well founded and if it were likely to produce airships which would be of national value in the event of war. Full consideration, he added, still further confusing the issue, was being given to the possibility of employing airships in connection with Imperial air communications.

Wireless Broadcasting.

IN the House of Commons on Tuesday the Postmaster-General was subjected to considerable criticism in the matter of his proposal to license the use of receiving sets in connection with wireless broadcasting services provided the receiving sets used were of British manufacture. Some members regarded the proposal as equivalent to the creation of a monopoly or the introduction of a novel form of protection. Yet the need for it, as stated in this Journal for June 23rd, has been emphasised by the Federation of British Industries and should be apparent to all on reflection. The sale or hire of the receiving sets will form the only means whereby the manufacturers will be enabled to recover the very considerable expenditure entailed in the broadcasting of the services. The foreign manufacturer, not having to meet these expenses, would be in a position greatly to undersell the home maker undertaking the broadcasting work. Mr. Kellaway proposes to make the restriction confining the licencees to the use of British receiving sets applicable for a period of two years. It seems doubtful whether such limitation will be acceptable to the manufacturers.

A London-Cologne Air Service.

THE Instone Air Line, which already operates air services between London and Paris and London and Brussels, proposes to institute shortly a regular daily service between London and Cologne *vid* Belgium. The distance involved is 310 miles and the air journey will occupy just over three hours. At Cologne connection, it is expected, will be made with a new German air service between the Rhine and Berlin *vid* Hanover. Berlin and London will thus be brought within about seven hours' flying of each other.

The Re-afforestation of Great Britain.

THE second annual report of the Forestry Commissioners shows that the denudation of the country's standing timber during the war is surely, if very slowly, being made good. The complete programme before the Commissioners covers the afforestation of 150,000 acres of new land, and towards its realisation the Government voted a sum of £3,500,000 under the Forestry Act of 1919 for expenditure before March, 1929. During the forest year of 1921 the total area planted amounted to 6463 acres, of which 4230 acres were new land and the remainder on the site of felled plantations. The total number of plants used was 12,805,000 and comprised 35 per cent. Scots and Corsican pines, 33 per cent. Norway and Sitka spruces, 17 per cent. European and Japanese larches, and 11 per cent. Douglas fir.

Experiments on Steam Engine Valve Leakage.

By J. E. RYCROFT, A.M.I. Mech. E.

A GOOD deal of prominence has been given recently to the question of economical steam production and the consequent waste of fuel which results from the low "working" thermal efficiency of the average steam-raising plant. The present high price of fuel has also had its effect in making imperative on the part of steam users the overhaul and improvement, where possible, of their methods of steam raising.

The equally important question of the proper

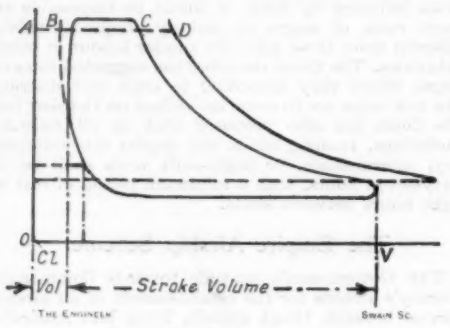


FIG. 1

utilisation of the steam when produced appears for the moment, except in special cases, to have been either lost sight of or relegated to the background. Take, for example, the controversy with regard to the "missing quantity" in steam engine cylinders, the exact cause of which does not appear to have been definitely settled one way or the other.

The weight of steam entering the cylinder of a double-acting engine per stroke is the measured steam consumption in pounds per minute divided by twice the revolutions per minute, and is known as the "cylinder feed." In Fig. 1 the volume of this weight of steam (weight × specific volume at pressure O A) is set off at B D on the volume calibrated mean indicator diagram, taken during a test when the steam consumption was ascertained. A B is the cushion or "play steam" and B C the indicated volume. In engines fitted with any type of slide valve, whether Corliss, piston, or the usual D type, it is found that the "indicated steam" is always less than the "cylinder feed," by an amount C D known as the "missing quantity."

Since the experiments made by Messrs. Callendar and Nicolson in 1897 on the leakage of ordinary D slide valves, the controversy above referred to has been carried on, the point in dispute being whether cylinder condensation or steam leakage accounted for the greater proportion of the missing quantity. Although individual firms of steam engine makers may have solved the question to their own satisfaction, so far as the author is aware no general solution has been reached and published, and in view of the important bearing of the subject on the design of steam engine valves, any further experimental evidence should be of interest.

Recently an opportunity occurred to the author of investigating the leakage of steam past a piston drop valve 9in. diameter, designed to supply steam to a central exhaust or uniflow engine. The valve and its casing, although arranged for experimental purposes, were identical in every vital respect with those used on an actual engine, as will be seen from the sectional drawing given in Fig. 2. The working tolerance of the rings was 0.004 of an inch measured cold.

Before giving the results of the author's experiments two conclusions arrived at by Messrs. Callendar and Nicolson, as published in the "Proceedings," Inst. C.E., 1897–8, may be briefly summarised as follows:

(*a*) That valve leakage takes place mostly in the form of moisture rather than as a direct leakage of steam, this water being forced through the faces by the "difference of pressure" on the two sides of the valve, and then being evaporated on the exhaust side.

(*b*) Leakage was found to be approximately expressed by the law—

Leakage in pounds per hour =

$$\frac{C \times \text{perimeter of valve} \times \text{pressure difference}}{\text{average overlap}}$$

and for the slide valve experimented with the constant C was found to = 0.02.

Experiments on a slide valve by Professor Capper, at King's College, London, the results of which were published in the first report of the Steam Engine Research Committee ("Proceedings," I. Mech. E., 1905), in the main confirmed the above-mentioned conclusions; but the leakage was found to be slightly greater when the valve was stationary than when it was in motion. Captain H. Riall Sankey measured the leakage past the piston valve and rings of a Willans engine, and with the usual amount of working tolerance between the valve casing and rings, found the leakage only amounted to about one-seventh of that which took place past a D slide valve, the value of the constant C being .003 instead of 0.02. It has been suggested that the small amount of leakage past a piston valve is to be ascribed to its simple circular shape being less susceptible to warping.

Mr. H. Denzil Lobley investigated the leakage of a piston valve, both when stationary and in motion, in a vertical jacketed cylinder, and the results were given in THE ENGINEER for February 9th, 1912. In these experiments leakage past the top portion of the valve only was measured, and the assumption was made that the leakage past the two portions was the same. The supposed constant C was found to vary with pressure difference, but the average value was given as 0.0022.

The first series of experiments undertaken by the author was directed to obtain the amount of dry or slightly superheated steam leaking past the valve when the pressure difference on the steam and exhaust sides of the valve was varied. The pressure difference could be arranged, either by varying the inlet pressure at the same time keeping the exhaust at constant atmospheric pressure, or by keeping the supply pressure constant and regulating the exhaust pressure by throttling the leaking steam.

The leakage was found to be uniform, so that experiments of ten minutes' duration were considered suitable, with observations taken every two minutes. Before commencing any experiment and after any variation in pressure, steam was blown through until steady conditions were obtained. The boiler supplying the steam was of the Lancashire type, 30ft. long by 8ft. diameter, and was fitted with a Sugden superheater.

The steam temperatures were taken by means of a platinum resistance pyrometer placed in close proximity to the liner of the valve and coupled to a direct-reading instrument. This pyrometer was tested against a standard mercury thermometer and found to be correct for the temperatures measured. All gauges were tested before and after use against a standard gauge and dead weight, and the gauge readings corrected accordingly. The steam in the valve casing acted as a jacket to the valve and liner, and the casing was provided with a drain cock, which was kept slightly open during the tests to get rid of any moisture.

Experiments 23 to 31. Saturated Steam. Supply Pressure Constant. Pressure Difference obtained by varying the Exhaust Pressure. Barometer, 30in. = 14.7 lb. per square inch.

No.	Gauge pressures.			Temperatures, deg. Fah.				Leakage.	
	Supply steam.	Exhaust steam.	Pressure difference.	Steam.	Cooling water. Entering.	Cooling water. Leaving.	Condensate.	In 10 min.	lb. per hour.
								lb. oz.	lb. oz.
23	146	0	146	365	52	140.5	59	10 13	64 14
24	144	10	134	364.8	52	134.8	58	10 13	64 14
25	145	20	125	365	52	132.5	58	10 13½	65 1
26	144	30	114	364	52	132	58.5	11 6	68 4
27	144	40	104	364	52	130	59.5	11 1	66 6
28	144	50	94	364.6	52	130	59	11 2	66 12
29	144	60	84	364.5	52	130	60	11 2½	66 15
30	146.5	70	76.5	365.8	52	130	60	11 0	66 0
31	146	80	66	366	52	127	60	10 15	65 10
								(Mean)	66 1

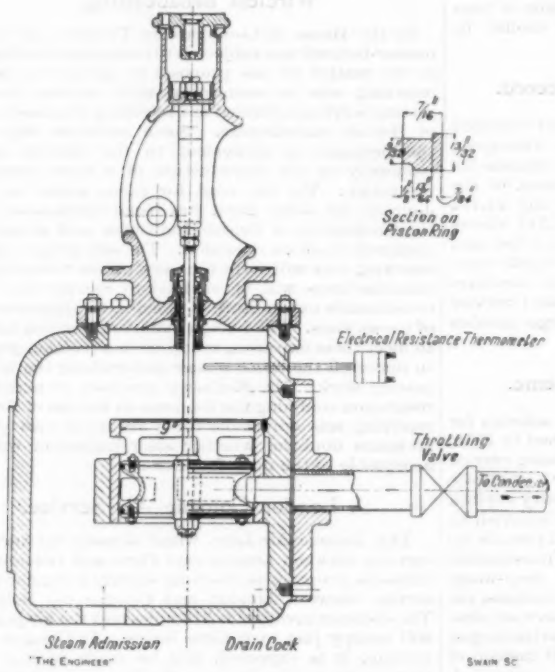


FIG. 2—EXPERIMENTAL VALVE

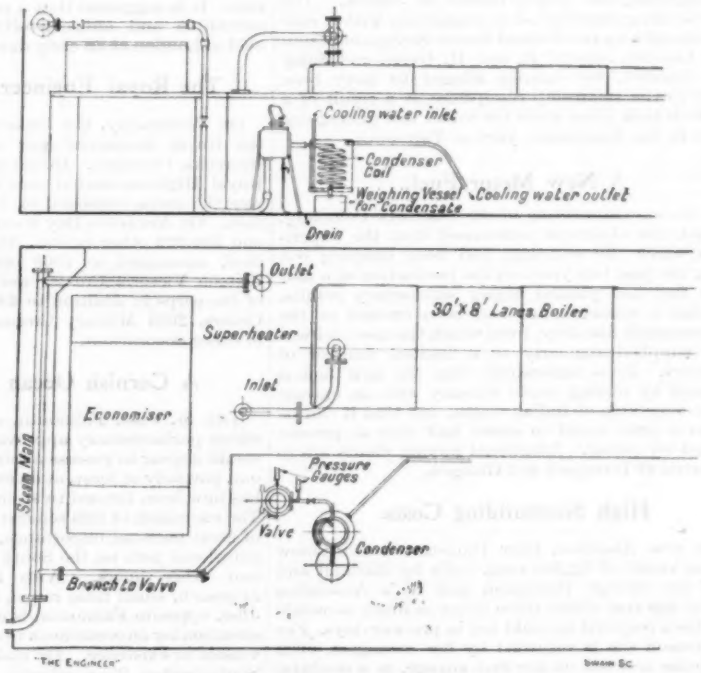


FIG. 3—ARRANGEMENT OF APPARATUS

The condenser consisted of a vertical coil of pipe inserted in a copper tank, the steam entering at the top and collecting after condensation in the weighing vessel, while the cooling water entered the bottom of the tank and was drained away at the top. A steady flow of steam for the purpose of driving a compound engine was maintained through the main steam pipe during the experiments, because erratic results were obtained when the engine was standing and the steam in the main pipe stagnant, except for the leakage flow in the branch pipe leading to the valve. The general arrangement of the experimental plant is shown in Fig. 3.

The tabulated results are as shown above.

A spring balance graduated to half ounces was employed for weighing, and was frequently calibrated and found correct. The gauge available for the exhaust pressure only read up to 80 lb. per square inch, so that greater pressure differences could not on this occasion be obtained. The results are shown plotted in Fig. 4. The mean line at 66 lb. 1 oz. shows that the leak was practically constant, although the pressure difference varied to the extent of 80 lb. per square inch.

Similar results were frequently obtained, thus showing conclusively that for this type of valve, for the range of pressure differences given above, the leakage depends on the pressure of the entering steam, and is independent of the exhaust pressure. It is obvious that if the pressures on the steam and exhaust sides of a valve were equal, no flow could take place; but the point at which the pressure difference reduces the leakage was not reached in the above experiments. The results thus indicate that Messrs. Callendar and Nichlson's conclusions were incorrect, and that leakage is proportional to the initial pressure rather than to pressure difference.

(5) The experiments to be repeated with the valve in motion at various speeds.

These experiments are being proceeded with as opportunity allows. The only conclusions to be drawn from the experiments so far completed are, that with the valve stationary and for the limits of pressure differences given, the leakage past a piston valve depends only on the pressure of the entering steam and is independent of the back or exhaust pressure; also that the missing quantity is chiefly due to cylinder condensation rather than to leakage. A 9in. valve, if only open to the extent required for a uniflow engine, will pass a large amount of steam so that a stationary leakage of 66 lb. per hour with a gauge pressure of 145 lb. per square inch would be almost inappreciable in accounting for the missing quantity.

From extended observations and trials the author is of the opinion that in the ordinary working condition in which slide valves are allowed to operate a considerable amount of leak takes place, and probably only special types of drop valve remain tight for very long without requiring attention, especially with high superheat.

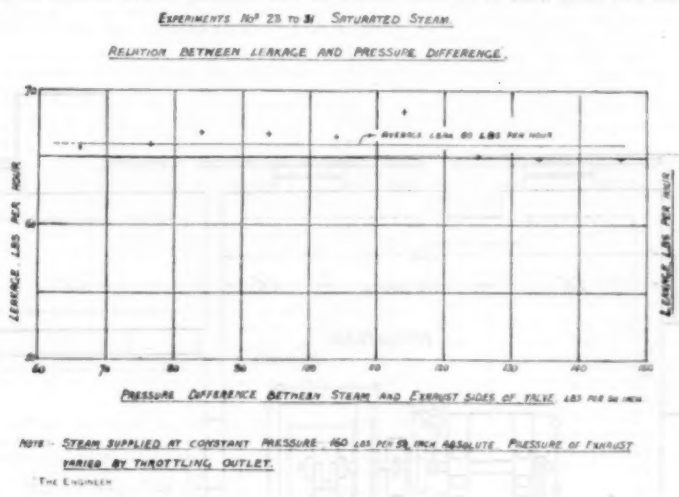

EXPERIMENTS Nos 23 TO 31 SATURATED STEAM.
RELATION BETWEEN LEAKAGE AND PRESSURE DIFFERENCE.
AVERAGE LEAK 66 LBS PER HOUR
LEAKAGE LBS PER HOUR
PRESSURE DIFFERENCE BETWEEN STEAM AND EXHAUST SIDES OF VALVE LBS PER SQ INCH
NOTE - STEAM SUPPLIED AT CONSTANT PRESSURE 160 LBS PER SQ INCH ABSOLUTE PRESSURE OF EXHAUST VARIED BY THROTTLING OUTLET.
THE ENGINEER

FIG. 4

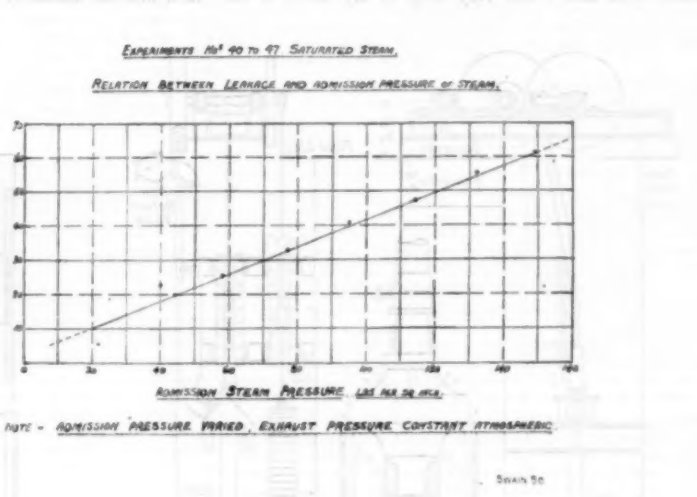

EXPERIMENTS Nos 40 TO 47 SATURATED STEAM.
RELATION BETWEEN LEAKAGE AND ADMISSION PRESSURE OF STEAM.
LEAKAGE LBS PER HOUR
ADMISSION STEAM PRESSURE LBS PER SQ INCH
NOTE - ADMISSION PRESSURE VARIED, EXHAUST PRESSURE CONSTANT ATMOSPHERIC.

FIG. 5

Experiments 40 to 47. Saturated Steam. Pressure Difference obtained by varying Entering Pressure. Barometric Pressure 30.05in. Hg., 14.7 lb. per square inch. Time, 10 minutes, mean of 2 minute readings.

No. of experiment.	Gauge pressures (corrected).			Temperatures, deg. Fah.				Leakage, lb.			
					Condensing water.			10 min.		Per hour.	
	Entering pressure.	Exhaust pressure.	Pressure difference.	Entering steam.	Entering.	Leaving.	Condensate.	lb.	oz.	lb.	oz.
40	149	0	149	360	50	110	58	10	3	61	2
41	132	0	132	350	50	101	58	9	4½	55	11
42	114	0	114	337.5	50	94	54	7	14½	47	7
43	95	0	95	324	50	86.5	54	6	12	40	8
44	77	0	77	307	50	82	53.5	5	7	32	10
45	58	0	58	288.5	50	77	55.5	4	4½	25	11
46	40	0	40	264.5	50	71.4	56	3	12	22	8
47	22	0	22	222	50	64	61	0	15	5	10

The usual leakage constant C when entering pressure of steam is taken instead of pressure difference, will be for a 9in. valve—

$$C = \frac{\text{leakage in pounds per hour}}{\text{entering press. (gauge)}} \times \frac{\text{mean overlap}}{\text{perimeter}}$$

$$= \frac{66.0625}{145} \times \frac{.2812 \text{ (width of ring)}}{2\,(9\text{in.} \times \pi)}$$

$$= .0022.$$

This result agrees with those previously obtained for this type of valve, but supposed to be obtained on pressure difference, when in reality they were based on the entering pressure only if the exhaust pressure were constant.

The results given in the second table are plotted in Fig. 5, from which it will be seen that the leakage follows approximately a straight-line law.

The coefficient C is remarkably constant, the average value, omitting experiment 47, being 0.0022; including No. 47, the value is 0.0021. It should be mentioned that the main steam pipe was well covered with non-conducting composition, and the experiments were carried out in close proximity to the boiler. During the first series of experiments, in order to obtain steam in the dry saturated or slightly superheated condition, the damper of the superheater was regulated accordingly.

The full scheme of experiments which it is proposed to carry out, as arranged at the outset, is as follows:—

(1) Effect on the leakage of varying the exhaust pressure to obtain the pressure difference with dry saturated steam.

(2) To find the leakage with various amounts of wetness and superheat.

(3) The effect of a measured oil supply, with both wet and superheated steam.

(4) The effect of alterations to the valve, *i.e.*, the width and the working tolerance of the rings.

The above-described experiments were carried out under the author's supervision by the third and fourth-year students of the Department of Engineering, Technical College, Bradford, and by kind permission of the head of the Department, Professor G. F. Charnock, M. Inst. C.E., M.I.M.E. Thanks are due to Cole, Marchent and Morley, Limited, Prospect Foundry, Bradford, who provided the valve and installed it in position.

The Institution of Naval Architects.

THE SUMMER MEETINGS IN PARIS.

WE have received from the secretary a copy of a written contribution by Sir Philip Watts on the papers presented by Sir Eustace d'Eyncourt and Major Fea. It runs as follows:—

Sir Eustace d'Eyncourt's paper is a most interesting contribution to the series of papers on warship design which our "Transactions" for the past four years contain. The series includes my paper in 1919, which gives a fairly full statement of the design particulars of the ships of the British Royal Navy at the outbreak of the war, and in the same year Sir Eustace d'Eyncourt's paper which dealt with warship construction during the war; then followed, in 1920, a paper from Sir Eustace on H.M.S. Hood, and in 1921 notes from him on German warship construction. Also in the same year there was a paper by Mr. S. V. Goodall, Constructor in the Royal Corps of Naval Constructors, on the ex-German battleship Baden; and in our spring meetings of the present year we had a paper by Mr. J. H. Narbeth, Assistant to the Director of Naval Construction, giving certain particulars relating to the designs of King Edward VII., Lord Nelson, and Dreadnought. All these papers were freely discussed by many naval officers and naval architects concerned with warship construction.

Sir Eustace's present paper deals with the aspect of the problem subject to the restrictions of the Washington Conference, which, in simple terms, involves the limitation of the number, displacement, and gun calibre of our capital ships. As contingent on these we have to consider the following:—(1) The best available protection from attack by enemy aircraft; (2) the best available deck protection from projectiles dropping from enemy guns; (3) the best available above-water broadside protection from enemy guns; (4) the best available protection from underwater torpedo attack, whether fired by submarines, torpedo craft, larger vessels, or otherwise; (5) the best available protection from mine attack; (6) the highest available gun power; (7) the highest available speed. There are, of course, other elements involved, *e.g.*, radius of action, but the above may, I think, be taken as the principal features.

Sir Eustace does not give many detailed particulars of the methods by which it is proposed to secure the best balance between all the conflicting elements of the problem. These, of course, we cannot expect. Our own and other Admiralties, at the present moment, are engaged in maturing their designs, and no one of them is likely to make an early pronouncement on the subject. To use a well-known phrase, we must "wait and see."

Sir Eustace's remark on page 1 "that all the existing types, perhaps with certain modifications, were of great utility" is perhaps rather fainter praise than he intended. Those types had to meet the enemy in all the principal naval actions, and it was with them the war was won. All the principal ships engaged at the Falkland Islands, Dogger Bank and Jutland were of pre-war design.

Sir Eustace points out that the older classes of battleships and cruisers (pre-Dreadnought ships) in almost all cases came off badly when struck by torpedoes. Most of these vessels which were sunk by a single torpedo were protected by a longitudinal vertical bulkhead along their side; when struck the side was smashed, the adjacent compartments flooded, and the ship capsized from lack of stability. In some cases the upsetting couple would have been less if there had been no middle-line bulkhead. In all cases the vessels sank through insufficient stability, and if they had had sufficient stability possibly none of them would have been lost. The newer forms of underwater protection referred to by Sir Eustace mainly depend on increasing the beam or breadth of the ship and thereby increasing her range of stability. The extent to which protection can be given against torpedo attack by placing armour and other resisting material in the side spaces is limited; a torpedo may get under the turn of the bilge and explode beyond this protection, and when the ship rolls to a comparatively small angle the whole of her bottom is exposed to attack, the target may be doubled or more than doubled, and most of it will be quite unprotected. The greatest safety lies, after reducing the size of the compartments to a minimum by suitable subdivision, in providing the most stability that is consistent with other essential requirements, to keep the ship upright as long as possible if compartments be flooded in succession.

It may be true that we can "at the moment" make our ships "reasonably secure" against torpedo attack to the extent of, say, two or even three explosions, when they are upright and not rolling, but underwater attack must be expected to grow in strength, torpedoes can easily be made of any desired power, and can be produced in a comparatively short time.

With regard to the greater range at which actions were fought, I am not sure than I am quite in agreement with Sir Eustace. In one of the early conferences held by Lord Fisher on the Dreadnought design, the probable course of events in an action supposing two hostile fleets or squadrons equally intent on fighting were to meet, was discussed, and it was agreed that firing would commence as soon as they got within such a range that there was a reasonable chance of hitting, say 14,000 yards with the 12in. guns of that day, which, with 13½ degrees maximum elevation, have a range of 15,000 to 16,000 yards. This was in the minds of the officers who had to deal with the distribution of deck and side protection. (Fighting at these ranges actually occurred in the war at the first encounter in 1914 when Admiral Sturdee's squadron met Von Spee's, also at almost every encounter afterwards). What we did not contemplate in the Dreadnoughts was that descending shell would get through our upper and main decks and fittings and travel considerable distances without exploding; it was anticipated that the shock would cause the fuse to act and the shell to burst before reaching the protective deck. This was pretty much the view held when war was declared. We soon found, however, that the German T.N.T. shell, with delay action

fuses, could penetrate our decks and travel considerable distances before exploding. This is why we had to increase the thickness of our armour decks over the vital parts of the ship.

I concur most heartily with Sir Eustace's statement that :—"The most powerful capital ship it is possible to construct still remains the prime necessity of any first-class navy." Much has been said to the contrary, but I strongly support Sir Eustace in his view. Lord Selborne, who was at one time, and a very critical one, First Lord of the Admiralty, and has given great attention to the matter, said in his place in the House of Lords on June 20th last :—"The Admiralty had done great service by standing fast on the question of capital ships. So far from the days of the capital ship being numbered, the lessons of the war proved the contrary."

Major Fea's paper is one of very great merit. It gives us another example of which many have been furnished, showing how very thoroughly Italian officers study matters relating to the design of warships. In fact, the matters involved here have been so fully and so clearly dealt with that I find very little to say inside of the general scope of what is presented to us beyond what Major Fea has himself said. I am, generally speaking, in entire accord with all Major Fea states.

There can be no doubt that the decisions of the Washington Conference create an entirely new position as regards the problem of warship design, and that much time and skill will be required to meet successfully the new conditions arising therefrom.

I am particularly interested in Major Fea's statement as to the possibility of reducing the number of the principal guns in a battleship when associated with great rapidity of loading, properly related to the time of the rolling of the ship, without real sacrifice in the offensive power of the main armament. I am not so sure that I agree with the proposal of Monsieur Doyere "to employ quadruple turrets." If the guns are to be 16in. guns, the resulting turret must not only be very large, involving special difficulties, but the concentration of such a large portion of the main armament in one turret involves a very serious risk of many guns being thrown out of action by a single blow.

I concur in the remarks made by Major Fea as to above-water armour deck protection, particularly where he says: "In other words, it would be advisable to sacrifice the part of the ship above the principal protective deck as long as we can, at any cost, save the one underneath."

Major Fea has done well, I think, in calling attention to the desirability of incorporating as far as possible the protective elements of a vessel with the structural features. This method of construction was adopted by me in the designs of the modern light cruisers of the British Navy. The difficulties of actual building were, of course, increased in comparison with those of earlier ships, but the resultant gain was considerable.

SOME deposits of manganese ore are being opened up in the county of Veszprém, in Hungary, and a company has been formed under the auspices of the Deutsche Bank to exploit the orefield.

Deep Bore-hole, Pump and Machinery

THE accompanying engravings illustrate a bore-hole pumping plant which has recently been installed at the waterworks of the Tetbury Urban District Council by Messrs. H. Brown and Co., of Prince-street, Bristol, to the specification and supervision of Mr. Henry J. Weaver, M.I. Mech. E., consulting engineer, of Gloucester. The plant was designed to raise 6000 gallons of water per hour from a depth of 400ft., and to deliver into a reservoir about 6ft. above surface level, situated 100 yards from the site of the boring.

The bore-hole was drilled by Messrs. Brown to a total depth of 446ft., the first 18ft. being a sunk well 8ft. square, lined with 9in. brickwork for containing the pump guides, counterweights, pump delivery chamber and air vessel. Below 18ft. the boring is lined with 14in. internal diameter mild steel tubes, ⅜in. thick, to a depth of 144ft. 10in., and below that again the bore is reduced to take tubes 12in. internal diameter, the well being lined to its total depth of 446ft. The 12in. tubes are, like the 14in. pipes, ⅜in. thick, and they are perforated at intervals with ¾in. holes for the access of water into the bore-hole.

The strata pierced was as follows :—

	ft.	in.
Top soil	2	0
Forest marble	22	6
Clay with stones	12	6
Forest marble	7	0
Sand	3	6
Great oolite	96	0
Grey shale	5	0
Fullers earth	6	0
Grey stone	16	0
Fullers earth	8	6
Blue marl	14	6
Fullers earth	65	0
Inferior oolite	135	0
Grey sand	52	6
	446	0

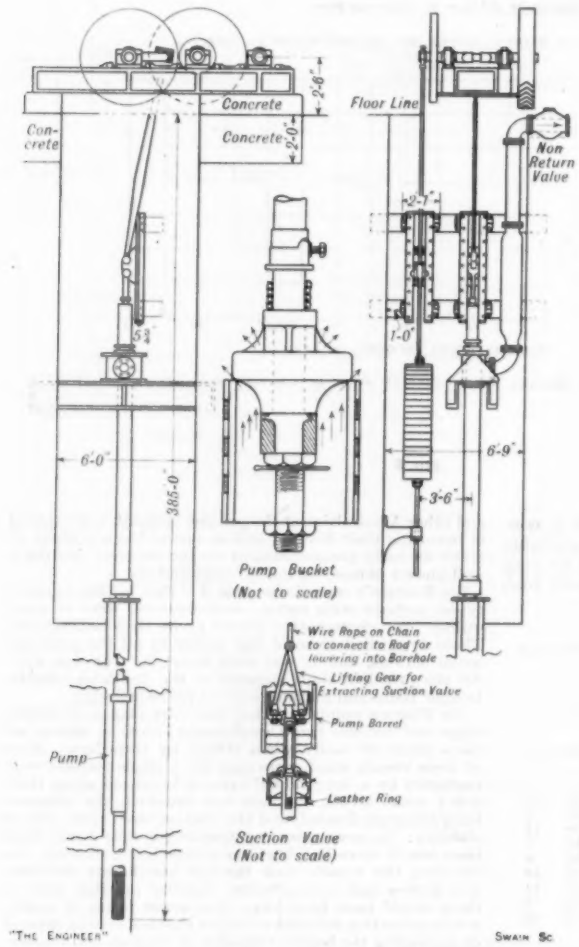
At the completion of boring operations, a test for the yield of the well was carried out for a period of fourteen days and nights continuously, the yield averaging out at approximately 5500 gallons per hour.

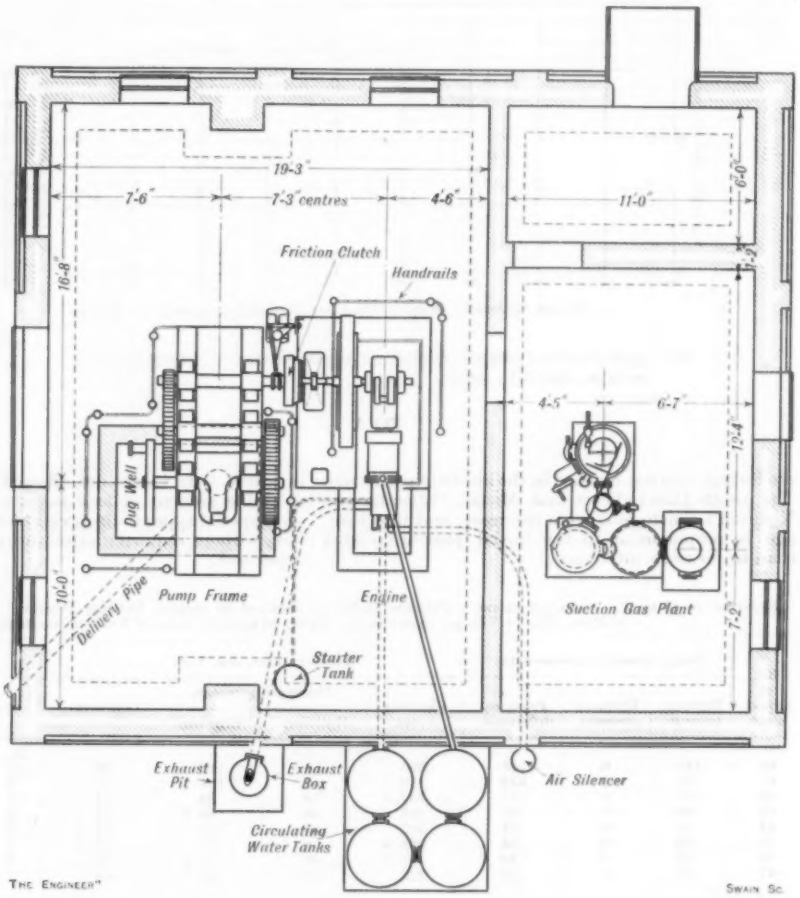
The permanent pumping machinery is driven by means of a 32 brake horse-power Fielding and Platt gas engine, which can run either on producer gas obtained from a suction gas producer, or on town's gas supply which is laid on to the waterworks.

As shown in the plan, the engine is coupled direct to the first motion shaft of the pump drive through the medium of an 18in. four-arm friction clutch, actuated by means of a hand wheel and screw, which gives a smooth and easy motion to the starting. This shaft runs at 250 revolutions per minute—the speed of the engine—and has keyed to it a forged steel pinion, having twenty teeth with a face of 6in. by 10in. diameter, which meshes with a cast iron spur wheel, having eighty-seven teeth, 6in. face by 43.5in. diameter, keyed to a 5in. shaft forming the second reduction. The opposite end of this shaft carries a forged steel pinion, with nineteen teeth, 8in. face by 12.33in. diameter, meshing into a cast iron spur wheel, with sixty-eight teeth, 8in. face by 45.33in. diameter, keyed to the pump crank shaft, which is 5¼in. in diameter and is carried in plummer blocks of the angle pattern. The revolutions of this crank may be varied between sixteen to eighteen per minute as required. The whole of the gears are carried on a cast iron frame of the box girder type braced together by end castings, and is placed immediately over the dug well.

The crank drives a plunger and bucket pump 375ft. below the surface through 4in. square pitch pine pump rods, working inside an 8in. internal diameter mild socketed steel rising main, ¾in. in thickness. The pump rods are coupled together by means of steel fish plates, and kept in alignment by guides arranged about every 15ft. These rods have a tendency to float in the water flowing up the main, which, of course, considerably reduces the work to be done in lifting them on the up stroke. The weight of the mains and pump, suspended in the bore-hole, is taken by two wire ropes passing down the boring, their pump end being threaded through a pair of wrought iron clamps bolted to the pump barrel, their other ends being connected to two straining screws secured to the girders which carry the guides in the dug well. The pump barrel, which is of cast iron, is 7¾in. in the bore, and has a 3ft. stroke. It is fitted with a gun-metal bucket, having gun-metal valves of the double beat type. Wings are cast on the valves, so that they can rotate on a central spindle as they rise and fall. The bucket can be drawn up to the surface for repairs through the rising main. The suction valve is of the same design, but provided with a mushroom head on the top of the valve spindle, so that the valves can be lifted to the surface by means of the special extracting tool shown in the engraving. When it is desired to remove the valve from its seat the tool is lowered down the rising main after the bucket has been extracted and the claws shown slip over the mushroom head, which can thus be lifted from its seating in the pump casting, which is turned on the taper, the valve casting being also on the taper and held in position by means of leather rings.

In the 18ft. dug well, the guides for the main pump and for the counterweights for balancing the weight of pump rods and the water in the main are fixed on cast iron girders built into the brickwork. The guides and slipper shoes are of cast iron, the latter being strengthened by steel side straps. The crosshead pins are of mild steel bored through the centres for lubricating purposes. The counter weight consists of cast iron and reinforced concrete blocks carried on a steel rod, which has a 3ft. stroke, the motion being imparted from a crank pin fixed in a cast iron disc keyed to the end of the crank shaft. The connecting-rods, which are also of mild steel, are 9ft. long from centre to centre of the bearings, and are fitted at the top with gun-metal marine type of heads, while the small end is bushed with manganese bronze. A cast iron plunger is provided for displacing the water in the main and for maintaining an even flow of water. It works through a deep gun-metal bushed gland in the delivery chamber, which is bolted down on cast iron girders fixed in the dug well The water is pumped through an air vessel, which is also fixed in the dug well, and is discharged into the reservoir by means of 6in. cast socket and spigot pipes. The guaranteed efficiency of the pump was 90 per cent.





BOREHOLE AND PUMPING MACHINERY AT THE TETBURY WATERWORKS

Railway Matters.

THE Trans-Zambesi Railway was opened, without any formal ceremony, on the 1st instant. The journey from Beira to Murassa, on the south bank of the Zambesi, can now be made in twenty-six hours.

A SERIOUS case of arcing on the New York Subway on the 6th instant led to the tunnel being filled with noxious fumes. Panic among the passengers led to 170 becoming unconscious. One newspaper report says that two passengers died.

THE success of the new signalling on the Mersey Railway—described in our issue of the 7th instant—has been such that further work is to be done at Liverpool Central Station. It will include the automatic operation of points and other special features.

FOLLOWING on the announcement made in this column a week ago as to an agreement between the North-Eastern and Great Central companies, comes the rumour that the negotiations with the Great Northern and Great Eastern companies are also virtually complete.

THE second annual dinner of the Institution of Railway Signal Engineers was held on the 14th inst., when the principal guests were Mr. W. B. Worthington, the President of the Institution of Civil Engineers, and Mr. J. S. Highfield, the President of the Institution of Electrical Engineers.

IT is a sad coincidence that the London, Brighton and South Coast Company has lost its station superintendents at London Bridge and Victoria by death within two or three weeks of each other. The death of the former in hospital after an operation was followed by the death on the 6th instant of Mr. G. Jeal, the station superintendent at Victoria.

IT is reported from Stockholm that the remaining link of the so-called inland railway, which stretches from Lake Vaener to Lapland, namely, the section between the stations Sveg and Brunflo, is now practically completed, and will be opened in September. By the completion of the railway large districts in the western part of north Sweden will be opened up.

THE railway statistics for March are now available. They show that in comparison with March, 1921, there was a reduction of 13.7 per cent. in the number of passenger journeys and of 19.1 per cent. in the passenger receipts. Partly because Easter fell in April this year and in March last year, the receipts from workmen's fares show an increase of 79.2 per cent.

ANSWERING a question on the 6th inst., Mr. Lloyd George said that there was undoubtedly a sharp division of opinion as to the Channel Tunnel; military opinion was hostile. Four days later, the Prime Minister was asked a further question on the same subject, when he replied that in view of the financial position of the country, the Government was not at present prepared to consider the question of the construction of the Tunnel.

IT is announced that the Norwegian Ministry of Labour has recommended the grant of a sum of 8 million kroner during the next budget period towards the Nore power station and the Numedal Railway. It is proposed to apply 3 million kroner of this sum to the Nore power station, and the remaining 5 millions to constructional work on the railway. In all, 7 million kroner had previously been voted for the Numedal Railway, while no less than 27 million kroner have been expended on the Nore scheme.

IT is reported that extraordinary developments have recently been made in the construction of rolling stock in Germany. The progress is such that the 150,000 goods trucks and the 5000 locomotives delivered to France by Germany after the Armistice have already been replaced by new material. By August 1st, it is estimated that the German railways will be in exactly the same situation as they were at the outbreak of war as regards the quantity of rolling stock, and even better off as regards the quality.

A GENERAL reduction on merchandise traffic by goods train, so that the rates and charges for that traffic will be 75 per cent. above the rates in operation on January 14th, 1920, in place of 100 per cent. above such rates, applying both to class rates and exceptional rates, will come into operation on Tuesday week. The flat rate increases of 1s. are to be reduced to 6d. and those of 9d. and 6d. to 4d. The rate for smalls is to be reduced from 150 to 100 per cent. above the rates in force on January 14th, 1920.

IN our description of June 16th of the Golders Green Extension and the enlarging of the City and South London tunnels, we said that the Borough Station would be closed in order to furnish accommodation for the contractors for the enlargement works. That event took place on the 17th inst., instead of waiting until August 8th as was originally announced. Those concerned should note that the City and South London Railway, as between Moorgate and the terminus at Euston, will be closed on and after August 8th.

ON the 4th instant one of the members for Leeds asked Mr. Churchill whether an order for locomotives for the Uganda Railway had been given to a Lancashire firm by private treaty instead of by public tender. Mr. Churchill replied that the Crown Agents' ordinary practice was to invite competitive tenders from the firms on their list, which, in the case of locomotives, included virtually all the firms in the United Kingdom which build locomotives. This procedure was followed in the case of five locomotives for the Uganda Railway, and the lowest tender which was accepted was accompanied by an offer to reduce the price by £30 a locomotive if the order was increased from five to seven. This information was telegraphed to Kenya, and as it had become possible to order an additional fifteen locomotives which were to be of identical design with the the original five the Crown Agents were instructed to take advantage of the firm's offer to reduce its price. As the result of negotiation with the firm the Crown Agents were able to secure not only the reduction of £30 per locomotive for the first five, but a reduction of £150 per locomotive for the additional fifteen. In his opinion the Uganda Railway authorities and the Crown Agents had acted prudently in this matter from the point of view of economy.

Notes and Memoranda.

WHAT are claimed to be the largest high-tension circuit breakers ever constructed have recently been made for the Mt. Shasta development, California, by the Westinghouse Company. They are for a 220,000-volt circuit, and weigh about 33 tons each.

THE proposal to combine the canal head works of the Sutlej Valley scheme with the Kaisar-i-Hind bridge of the Indian North-Western Railway is adversely commented on in *Indian Engineering*. The present bridge, which was constructed in 1885–7, has twenty-seven spans of 145ft. each, and it is proposed to substitute a bridge of eighteen spans, of which the central dozen would be fitted with gates 60ft. wide and the side spans with undersluices. The Indian journal suggests that it would be much better to have two separate structures for the two purposes.

DAMASCUS is well provided with water from the Barada River. The fall at Tekieh on this river also provides the power for the tramway and electric lighting of the city. The installation is Belgian, and there are at present four dynamos of 250 horse-power each. The tariff is 9 Pst. Syr. per kilowatt for light and 5 Pst. Syr. for power (1 Pst. = 20 centimes). The subscribers in both categories number 15,000, and owing to shortage of power no new subscribers of the second category are at present accepted. There is talk of increasing the power by using a second fall.

AT a recent meeting of the Society of Glass Technology, in Sheffield, Mr. L. E. Norton gave an account of the work he had done on the swelling of sand on the addition of water. Three typical sands were used in the experiments, and it was shown that in each case the addition of water caused such a swelling in the sand that the moist sand would more than fill a vessel which would hold the same sand when dry. This excess may be as much as 12 or 15 per cent. of the total dry sand. In each of the three cases there appeared to be a maximum amount of swelling when about 5 or 6 per cent. of water was mixed in with the sand.

AN article in the *Engineering News-Record* suggests the possibility of using natural water power as an auxiliary to steam plant for carrying peak loads. From the standpoint of reliable peak-carrying capacity many an otherwise unattractive water power can be, it is urged, used advantageously as an auxiliary to a steam-electric system, and a more extensive use of hydro-electric power for this purpose appears clearly to be indicated. The economies involved are a most interesting study in themselves, though it might be pointed out that the savings resulting from the use of water power to carry the top of the peak load are dependent primarily on the cost of installing and maintaining steam-electric generating capacity rather than on local cost of fuel.

THE production of copper in Katanga in the Belgian Congo for the month of May reached a total of 3798 tons, and for the month of June 3982 tons, which constitutes a record. During the first six months of the current year the output of the foundries in Katanga totalled 20,939 tons of copper. This gives promise of a total output for the year of 40,000 tons as compared with 30,000 tons last year. According to the latest prospecting in a portion of the copper-bearing region, it is estimated that there are reserves of copper ore amounting to 65,000,000,000 tons approximately, capable of yielding about 4,400,000 tons of copper. The tin mines of Busanga produced 600 tons of cassiterite—tin stone—in 1921, as compared with an output of 340 tons in 1920.

THE untapped stocks of petroleum in the United States were recently estimated at 9,150,000,000 barrels, and world resources at from 65 to 70,000,000,000 barrels. A significant feature of the American consumption is the fact that that country's oil resources are being utilised more rapidly than are the supplies outside the States—in proportion to their volume, much more rapidly. More than three-fifths of the world's ouptut is produced in the United States. The reported output in the States increased from 248,000,000 barrels in 1913 to 469,000,000 in 1921, and the estimated world output in the same period increased from 384,000,000 to 759,000,000 barrels. America's reserves represent about twenty year's supply at the present rate of production. Production of crude oil in the States, added to imports, has exceeded consumption for more than two years. In consequence, stocks have accumulated in unusual quantities, especially since 1920.

AN adaption of the low-temperature process for the carbonisation of coal, which has been worked out in Berlin, is described in the *Chemical Trade Journal*. In this arrangement the coal is supplied from a high overhead bunker, and passes through what is called a "distilling shaft," an almost vertical cylinder in front of the boiler, on its way to the mechanical stoker. The coal in the bottom of this shaft is heated by the red-hot mass burning on the first portion of the stoker, and is partially carbonised. The gases and vapours pass off through a pipe from the top of the distilling shaft, are extracted by a pump, and passed through a condensing plant, which separates motor spirit, tar and ammonia as usual. The incondensable gaseous products are then passed to the back end of the mechanical stoker, so as to aid in completing the combustion of the ash and clinker. The over-all efficiency of the installation is said to be about 86 per cent.

THE submarine cast iron pipe, 36in. in diameter, which conveys water across the Narrows from New York to Staten Island, has ball and socket joints, so that it could be laid from a barge like a cable. Two rows, each of sixteen holes $\frac{3}{4}$in. in diameter, were drilled around the socket of each pipe. After approximately 250 lb. of lead had been cast into each joint on the barge, 144 lead slugs, $1\frac{3}{4}$in. long and $^{9}/_{16}$in. in diameter—total weight 26 lb.—were forced into the shrinkage space left between the pipe and the lead as the latter cooled by means of steel screws operated by a special tool, and with them flake graphite and grease as a lubricant. At first each joint was tested as made with water under 100 lb. pressure, but these joints were so uniformly tight that tests were discontinued. After the pipe line had been completed, which required two seasons, with a winter's interruption, a forty-day test under 110 lb. pressure showed a leakage of only 3 quarts per minute from more than 800 joints.

Miscellanea.

IT is hoped before long to increase the capacity of the paper mill at Seven-mile Creek, near Hankow, China, by the installation of additional machinery.

AT a meeting of the Provisional Committee of the Institution of Chemical Engineers the following definition was agreed upon:—"The Chemical Engineer is a professional man experienced in the design, construction, and operation of plant in which materials undergo chemical or physical change."

THE mean yield in 1920 from the Kilo-Moto goldfield, in Northern Congo, was 3.5 grammes of gold per cubic metre at Kilo and 1.70 gramme at Moto. At Moto, last year, a claim, sluice-worked, yielded 0.6 gramme per cubic metre and yet was worked with profit. This performance is said to be a world's record.

AN esparto cellulose factory for making paper and powder is being erected at Benalua de Guadix, Granada, according to the *Raw Materials Review*. The cost assigned to it is 9,000,000 pesetas. The power will be derived from the river Dilar, where two sets of electric generators of 2200 horse-power each will be installed.

BRITISH Columbia is spending approximately 1,500,000 dollars on the construction of new roads this season, in addition to the annual maintenance expenditure on existing roads, and this Province will, according to the Minister of Public Works, do its part in advancing the completion of the trans-Canada highway scheme.

THE battle-cruiser Hood has returned to Devonport, and whilst she is giving summer leave the dockyard will be preparing her for the forthcoming voyage to Rio de Janeiro, to participate in the international celebrations in connection with the establishment of the Brazilian Republic. The Hood is, of course, to be accompanied by the Repulse.

IT is stated locally in Southend that the Corporation's Electricity Committee has decided to recommend the adoption of Mr. Birkett's scheme for the supply of electricity in the immediate future. This would mean the continuation of Diesel generating plant for a time, and incidentally the abandonment of the turbo-generator scheme.

THE old Norfolk suspension bridge over the river Adur at Shoreham is to be pulled down and replaced by a modern structure. The bridge is about ninety years old, and for some years has been closed to heavy traffic. The reconstruction, which is to be carried out by the Unit Construction Company, will probably occupy about five months.

A FINE sample of aluminium sulphate which had been discovered north of the city, was recently brought into Edmonton, Alberta. This deposit is said to be over 4ft. thick, and the value is listed on the New York market at $2\frac{1}{2}$ cents per pound. The sample is absolutely free from iron, and in its natural state could be shipped for chemical purposes.

THE Government of India is proposing to establish an inland system of low-speed wireless stations. The scheme does not include wireless communication with Britain, but will be adaptable to the Imperial wireless scheme when this is in operation. The rapidity of the development of the scheme will naturally depend on the welcome accorded to it by local Governments and the Indian States.

THE Compagnie Générale de Télégraphie sans Fil is building a big wireless station at Phuto, near Saigon. The station will be started in September. It will communicate directly with the stations at Sainte Assise and Tananarise. The energy needed will be drawn from the Energie Electrique de l'Indo-Chine, which company is now building near Saigon a generating station of 3000-kilowatts capacity.

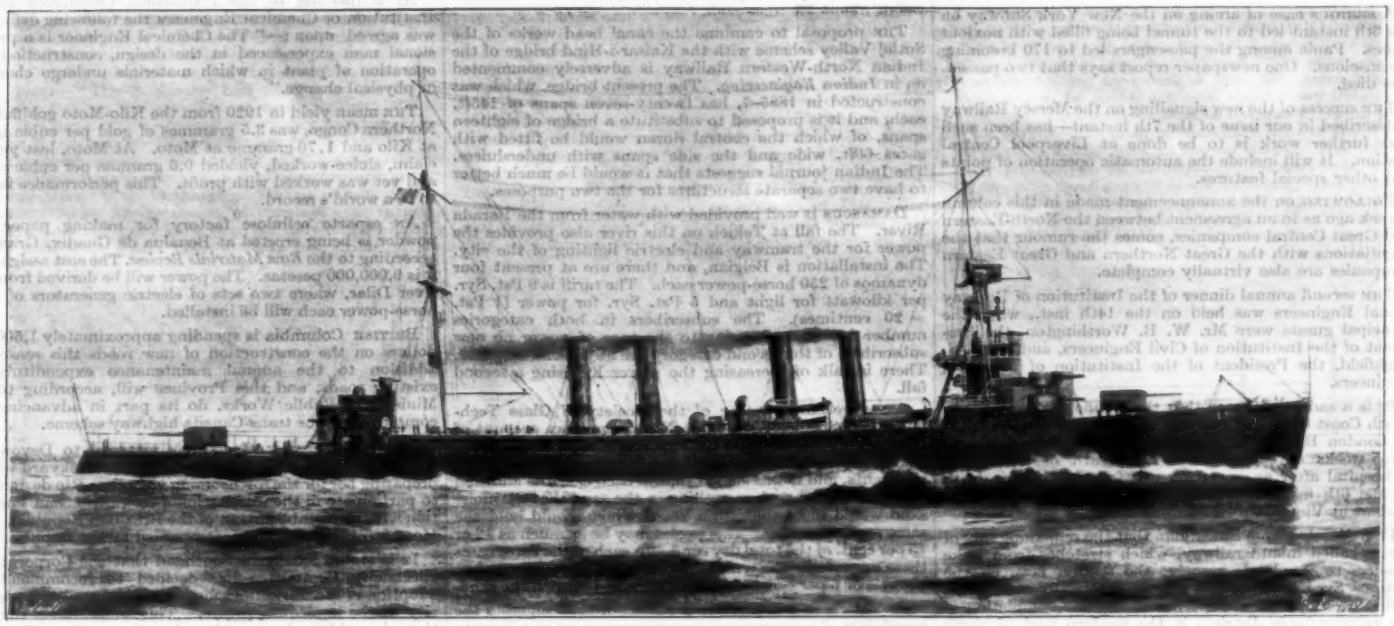
UNDER the presidency of M. Chuard, Chief of the Swiss Département Fédéral de l'Intérieur, a conference has been held dealing with the questions of navigation on the Rhone and the regulation of the Lake of Geneva. Members of the mixed delegation to the Franco-Swiss Upper Rhone Commission took part in the conference, which approved in principle an increase in the extent of variation of the level of water of the Lake of Geneva, subject to guarantees necessary for the safeguarding of the interests of the lake-side owners and inhabitants, and on condition that France should contribute, on her side, towards a satisfactory solution of navigation questions. The decisions arrived at will permit of the early resumption of negotiations with France, which had been broken off after the conference of February 25th, 1919.

IN moving in the House of Assembly, on July 14th, the second reading of the Iron and Steel Industry Encouragement Bill, Mr. Malan, the Minister of Mines and Industries in the Union of South African Government, said that the main reason why the smelting industry hitherto had not been developed in the Union was the lack of capital. The present Bill, he explained, provided a system of bounties for approved concerns capable of achieving an output of 50,000 tons of pig iron or steel annually. By a graduated system, bounties would be payable on the amount of the first three years' output at the rate of 15s. per ton of pig iron and a further 15s. per ton for steel manufactured out of pig iron, and thereafter at a diminishing rate until the expiration of the measure at the end of eight years, when he hoped Government assistance would be no longer needed.

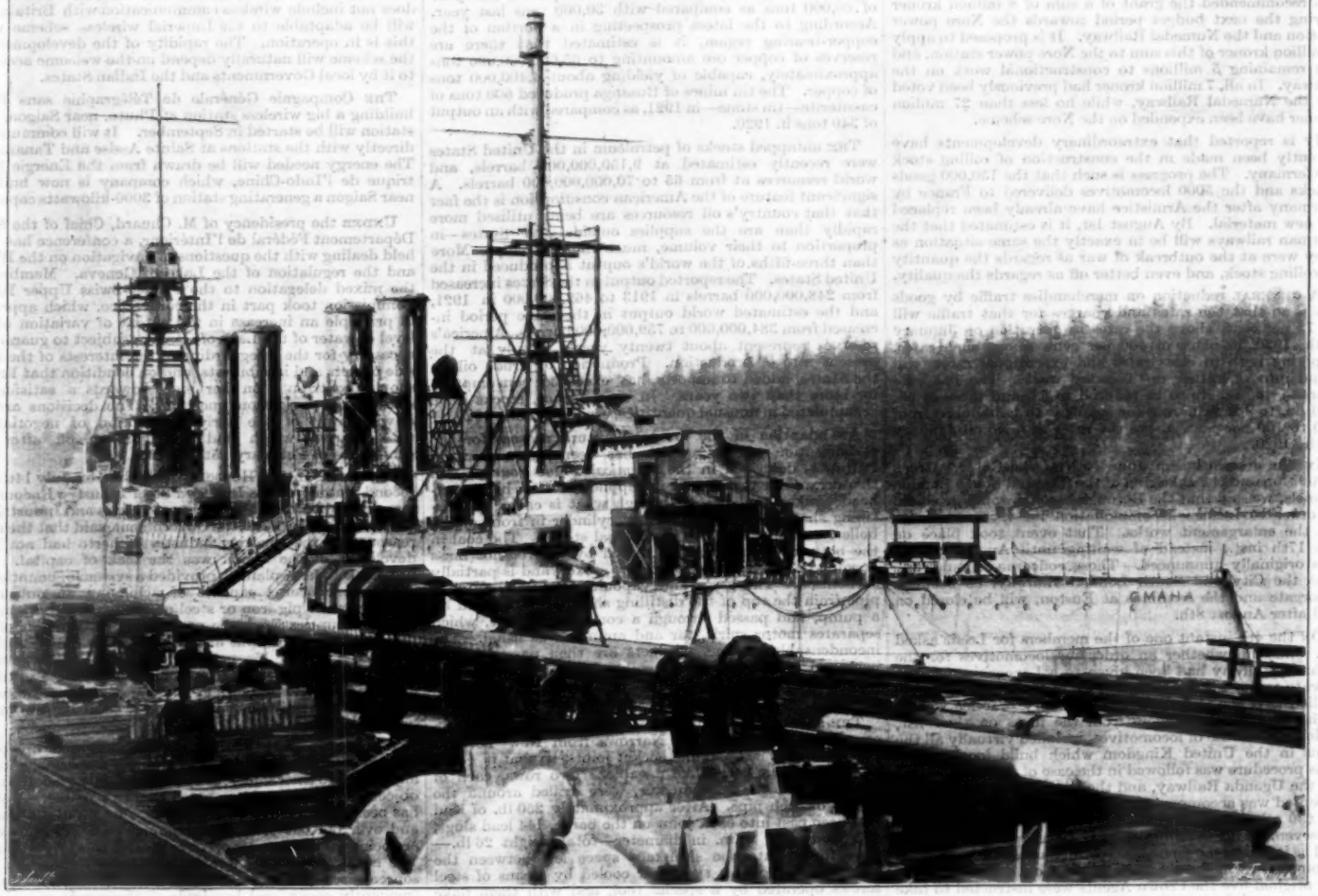
THE coal mines in the Valley of the Donetz are being eagerly exploited, according to M. J. de Lubersac, without any regard to their safety, or to the damage caused, the main object being to extract as much coal as possible. A stock has been accumulated of over 1,000,000 tons of anthracite, and over 600,000 tons of bituminous coal. No measures are being taken to transport or to market this large tonnage. The coal rapidly deteriorates, and its accumulation is a source of serious danger. Cases of spontaneous combustion frequently occur, and hundreds of thousands of tons are likely to perish before they can be brought into use. The work of extracting the coal nevertheless continues, and the stocks are increasing daily. It is a striking proof of the disorganisation of Russian industry that, in spite of the large stocks of coal accumulated in the Ukraine, the steamers which bring coal to the port of Mariupol are compelled to buy English or other coal.

THE UNITED STATES LIGHT CRUISER OMAHA

(*For description see page 55*)



THE VESSEL AS SHE WILL APPEAR WHEN COMPLETED



IN THE FITTING-OUT BASIN

AGENTS ABROAD FOR THE SALE OF

The Engineer

BUENOS AIRES.—MITCHELL'S BOOK STORE, 576, Cangallo.
CHINA.—KELLY AND WALSH, Limited, Shanghai and Hong Kong.
EGYPT.—CAIRO EXPRESS AGENCY, near Shepheard's Hotel, Cairo.
FRANCE.—BOYVEAU AND CHEVILLET, Rue de la Banque, Paris; CHAPELOT AND CIE., 136, Bld. St. Germain, Paris.
BELGIUM.—W. H. SMITH AND SON, 78/80, Rue du Marché-aux-Herbes, Bruxelles, and 44, Rue Joseph II., Ostend.
INDIA.—A. I. COMBRIDGE AND CO., Bombay; THACKER AND CO., Limited, Bombay; THACKER, SPINK AND CO., Calcutta.
ITALY.—MAGLIONI AND STRINI, 307, Corso, Rome; FRATELLI TREVES, Corso Umberto I, 174, Rome; FRATELLI BOCCA, Rome; ULRICO HOEPLI, Milan.
JAPAN.—MARUZEN CO., Tokyo and Yokohama.
AFRICA—WM. DAWSON AND SONS, Limited, 7, Sea-street, (Box 49), Capetown.
C. JUTA AND CO., Johannesburg, East London, and Grahamstown.
AUSTRALIA.—GORDON AND GOTCH, Limited, Melbourne, Sydney, Brisbane, and Perth, &c.
MELVILLE AND MULLEN, Melbourne.
ATKINSON AND CO., Gresham-street, Adelaide.
CANADA.—DAWSON, WM., AND SONS, Limited, 87, Queen-street East, Toronto.
GORDON AND GOTCH, Limited, 132, Bay-street, Toronto.
MONTREAL NEWS CO., 386-388, St. James-street, Montreal.
TORONTO NEWS CO., 42, Yonge-street, Toronto.
CEYLON.—WIJAYARTNA AND CO., Colombo.
JAMAICA.—EDUCATIONAL SUPPLY CO., Kingston.
NEW ZEALAND.—GORDON AND GOTCH, Limited, Wellington and Christchurch; UPTON AND CO., Auckland; J. WILSON CRAIG AND CO., Napier.
STRAITS SETTLEMENTS.—KELLY AND WALSH, Limited, Singapore.
UNITED STATES OF AMERICA.—INTERNATIONAL NEWS CO., 83 and 85, Duane-street, New York; SUBSCRIPTION NEWS CO., Chicago.

Agents Abroad for Advertisements.

UNITED STATES OF AMERICA.—BRITISH AND COLONIAL PRESS, Inc., 736, The Knickerbocker Building, 152, West 42nd-street, New York City.
FRANCE.—AGENCE VOX, 7, Rue de Surene, Paris (VIIIe).
BELGIUM.—W. H. SMITH AND SON, 78/80, Rue du Marché-aux-Herbes, Bruxelles, and 44, Rue Joseph II., Ostend.

SOUTH AMERICAN BRANCH OFFICE OF

The Engineer.

526, Bolsa de Comercio, Buenos Aires.

SUBSCRIPTIONS.

THE ENGINEER can be had, by order, from any newsagent in town or country, at the various railway stations; or it can, if preferred, be supplied direct from this office.
Half-yearly (including index number) .. £1 12s. 6d.
Yearly (including two index numbers) .. £3 5s. 0d.
If credit occur, an extra charge of two shillings and sixpence per annum will be made.

Foreign Subscriptions will be received at the rates given below. Foreign subscribers paying in advance at these rates will receive THE ENGINEER weekly and post free. Subscriptions sent by Post Office Order must be made payable to THE ENGINEER and accompanied by letter of advice to the Publisher.

THIN PAPER COPIES.		THICK PAPER COPIES.	
Half-yearly	£1 11s. 6d.	Half-yearly	£1 13s. 9d.
Yearly	£3 3s. 0d.	Yearly	£3 7s. 6d.

(The difference to cover extra postage.)

Canadian Subscriptions—
Thin paper edition .. .. £2 18s. 6d. per annum.
Thick paper edition .. .. £3 3s. 0d. ,,

*** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 9d. each, 5s. 3d. post free.*

ADVERTISEMENTS.

*** The charge for Situations Open and Wanted Advertisements of four lines and under is four shillings, and one shilling per line for each additional line up to one inch. When an advertisement measures an inch or more the charge is twelve shillings per inch. The rates for all other classes of advertisements, other than those mentioned above, are included in "THE ENGINEER Directory," which is sent post free on application. All single advertisements from the country must be accompanied by a remittance in payment. Alternate advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.

Small Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication). ALTERATIONS to STANDING ADVERTISEMENTS must arrive not later than THURSDAY of the week preceding publication.

Letters relating to Advertisements and the Publishing Department of the Paper are to be addressed to the Manager, all other letters to be addressed to the Editor of THE ENGINEER.

Postal Address, 33, Norfolk-street, Strand, W.C. 2.
Teleg. Address, "Engineer Newspaper, Estrand, London."
Telephone Nos. 2256, 2257 Central.

PUBLISHER'S NOTICES.

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

TO CORRESPONDENTS.

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

By arrangement with Reuter's Engineering Service, The Engineer contains the latest news from all parts of the world which is likely to be of interest to engineers.

Contents.

THE ENGINEER, JULY 21st, 1922. PAGE

AN AMERICAN HIGH-SPEED CRUISER AND ITS PROTOTYPE. (Illus.) 55
THE ROYAL SHOW AT CAMBRIDGE.—No. III. (Illus.) 57

LETTERS TO THE EDITOR—
Water Raising 60
Electric Cooking 60
The Expenses of Applicants 60
Gas from Sewage Filters 60
Vane Wheel Propellers 60

A SEVEN-DAY JOURNAL 61
EXPERIMENTS ON STEAM ENGINE VALVE LEAKAGE. (Illus.) .. 62
THE INSTITUTION OF NAVAL ARCHITECTS 63
DEEP BOREHOLE PUMP AND MACHINERY. (Illus.) 64
RAILWAY MATTERS 65
NOTES AND MEMORANDA 65
MISCELLANEA 65

LEADING ARTICLES—
The Vindication of the Capital Ship 67
Annealing 68

CHINESE ENGINEERING NOTES 68
THE WORK OF THE SCHOOL OF ENGINEERING, GIZA, EGYPT. (Illus.) 69
SURFACE CONDENSING PLANT. (Illus.) 70
CENTRIFUGAL CASTINGS. (Illus.) 72
RAILWAY ACCIDENTS 73
NEW FRENCH ALUMINIUM-BRONZE MONEY. (Illus.) 74

PROVINCIAL LETTERS—
Midlands and Staffordshire 75
Lancashire 75
Sheffield 76
North of England 76
Scotland 77
Wales and Adjoining Counties 77

LATEST NEWS FROM THE PROVINCES 77
CURRENT PRICES FOR METALS AND FUELS 78
FRENCH ENGINEERING NOTES 79
BRITISH PATENT SPECIFICATIONS. (Illus.) 79
CATALOGUES 80
FORTHCOMING ENGAGEMENTS 80
EDUCATIONAL INTELLIGENCE 80
LAUNCHES AND TRIAL TRIPS 80

PARAGRAPHS—
Contracts 80
A New Piston Ring 80
Supply of Water to Steam Wagons 80

THE ENGINEER.

JULY 21, 1922.

The Vindication of the Capital Ship.

ALL doubt as to whether the construction of our two "post-Conference" battleships would be undertaken has now been set at rest by the First Lord of the Admiralty, who stated in the House of Lords on July 11th that the Government had not reconsidered its decision to proceed with the building of these vessels, nor did it intend to do so. The necessary designs, he added, had already been worked out and approved, and were ready for the use of the builders. The actual date of laying down the ships is not yet known, but, according to the First Lord's memorandum on the Navy Estimates, it will be "early next year." In the measured judgment of the Admiralty it is feasible to make the new battleships "reasonably proof against any known or likely methods of attack," an opinion which is based on the experience derived both from war operations and a long series of experiments presumably carried out since the war. In view of the high professional competence of the present Board of Admiralty—all of whose naval members saw prolonged service afloat in the late conflict—the public at large will be inclined to accept as final its verdict as to the indispensability of the capital ship. True, it is warmly challenged by several naval officers of distinction, who believe the armoured leviathan to have been rendered obsolete by submarine and aerial methods of offence, and support their thesis by arguments which might be conclusive if they rested on demonstrated fact instead of surmise. As it is, however, the case for doing away with the battleship has not been proved, and in these circumstances the country is satisfied with the decision of the responsible controllers of its naval policy that two new capital ships shall be added to the establishment at an estimated total cost of £16,000,000. It seems an exorbitant sum to pay for only two ships, considering that eight pre-war Dreadnoughts could have been built for the same nominal outlay, but some allowance must be made for depreciation in the purchasing power of money. Probably, therefore, it is accurate to say that the cost of the battleship has doubled rather than trebled. Even so, there would be good reason to question the wisdom of spending so much money on new vessels of this type if it were certain that they could be destroyed as easily as their critics affirm. We are told, for instance, that "one bomb dropped by an aeroplane could sink the strongest battleship ever built or projected." No doubt it could, provided the ship was a stationary target, deserted by its crew, incapable of offering any active resistance, and that the aeroplane could drop a heavy bomb in the precise position where it would explode with maximum effect; but such a conjunction of favourable circumstances would be most unlikely to occur under war conditions.

It seems to us that critics of the battleship display too much imagination and too little regard for actualities. Although few of them appear to be aware of it, they are repeating much the same objections to the heavy ship as were raised in some quarters forty to fifty years ago, when the potentiality of the big gun and the torpedo was urged as a reason for building no more warships of large tonnage. Then, as now, the anti-battleship party was able to quote authenticated data in support of its views. As evidence that the heaviest ironclad might be wrecked by a single shot they pointed to the ease with which thick armour had been holed at the proving butts in England, France and Germany by the monster guns which each of those Powers had constructed; while the Resistance trials in England and similar experiments on the Continent were cited as confirmation of the theory that a single "fish" or spur torpedo could destroy the buoyancy of any man-of-war afloat. They either overlooked or discounted the fact that proving ground results were notoriously misleading as a guide to the performance of ordnance when mounted on shipboard and worked under battle conditions, just as they grossly exaggerated the chances of successful torpedo attack in the confusion and turmoil of a fleet action. As regards the first point a commentator of 1881 observed that "the superiority of the gun becomes much less marked under the practical conditions of a naval engagement. It is possible, as it has been shown, to penetrate the heaviest armour, but in experimental firing the targets are fixed at short distances and receive perpendicular blows from guns which can be laid with the utmost accuracy. These are conditions which can rarely obtain in an actual engagement." Subsequently the difficulties of carrying out torpedo attacks and the shortcomings of the new weapon were demonstrated by naval operations in the Black Sea and South American waters, and in the end the continued supremacy of the battleship was conceded by all save a negligible minority. The parallel between this early controversy and the one now in progress is sufficiently close to merit attention. Present-day opponents of the great ship are particularly impressed—or shall we say obsessed?—with the devastating effect of heavy aircraft bombs detonating below the water close alongside, as happened in the Ostfriesland trials. From what resulted on that occasion it was clear that serious damage had been inflicted. The Ostfriesland did, in fact, sink, but not so rapidly as to refute the suggestion that had there been a well-trained crew on board she might have been kept afloat. That the ship was perfectly motionless during the attack we know, and it is admitted that the airmen released their bombs from a height considerably less than they could have maintained with safety had they been under the fire of well-served anti-aircraft guns. On the whole, therefore, this particular experiment bore no more relation to war conditions than did the proving-ground artillery experiments or the torpedo trials of a generation ago, and it is not surprising that the Admiralty should decline to abandon battleships merely on the strength of a single inconclusive demonstration. The matter would, of course, assume a very different complexion were it certain, first, that battleships will in future be frequently exposed to attack by the heaviest types of bombing aircraft; and, second, that a fair proportion of large bombs will fall on or close alongside the objective; but no such certainty exists. No doubt hits would be made from time to time, the effects of which might be disastrous, but in our judgment the contingency is not a sufficient pretext for discontinuing the building of large warships. The impression probably left in the mind of an uninstructed reader by much that has been written in the course of the newspaper controversy is that, prior to the advent of the submarine and the aircraft, battleships enjoyed almost complete invulnerability and were in no danger of that summary destruction with which they are threatened now. That, needless to say, is an entire fallacy. Large calibre projectiles containing a high-explosive charge have long represented a formidable menace even to stoutly armoured ships, a menace which has become particularly serious since the introduction of the "Dreadnought" type, with its large battery of heavy guns and the consequent development of salvo firing. Jutland furnished an object lesson on the tremendous power of modern naval artillery, for in that action several great capital ships were utterly destroyed by a few salvoes of shell fired at long range. Whatever the anti-battleship school may assert to the contrary, it is

none the less true that a large vessel can be made reasonably safe against under-water explosions by bulge and other forms of protection, which in a perfected form ought to confer the same degree of immunity against aircraft bombs as against torpedoes. But it is practically impossible to design a ship which shall be impermeable to heavy gunfire. If, therefore, the gun platform can be made secure against exiguous attack below the waterline, there would seem to be no reason for doubting the continued primacy of the capital ship, which is essentially a platform for the carriage of heavy ordnance. Such security was declared to be attainable by Sir Eustace d'Eyncourt, the Director of Naval Construction, in his paper at the recent Paris meeting of the Institution of Naval Architects, and is confirmed by Sir Philip Watts in his written remarks on that paper which we print to-day. We have no doubt this double assurance from two of our greatest warship designers will carry more weight with the public than unsupported statements to the contrary by critics of the Admiralty's shipbuilding policy.

As we have remarked, the position to-day is fundamentally similar to that which existed nearly fifty years ago, when the advent of the locomotive torpedo raised doubt in many minds as to the expediency of continuing to build costly armourclads, and when ardent torpedoists were no less positive than our present-day aircraft enthusiasts that the great ship had lost its *raison d'être*. Naval opinion fortunately took the longer view, as in the main it does at the present juncture, with the result that Britain remained supreme on the ocean for a further generation by virtue of her splendid armour-clad fleet. We venture to think that the following words, spoken as far back as 1877 by the late Sir E. J. Reed in a discussion on "Warships and Torpedoes," are as apposite to the circumstances now prevailing as when they were uttered: "Here, then, we have every Power furnished with the means of attacking our large warships, so cheap and so simple that few Powers are too petty-or too impecunious to provide them on an emergency, while the larger Powers could, with the financial means at their disposal, completely compass and surround our few largest and finest ships with those agents of destruction. In my opinion this state of things imposes altogether new and solemn obligations upon our naval administrators, and the objects to which it points are clearly twofold—first, the construction of our large ships on principles which make them as little destructible by torpedoes as by guns, which I believe to be quite possible; and, secondly, the building of all our other warships of small and handy types, and with the necessary improvements. With these objects neglected, we shall be placed in a position of serious disadvantage and danger; with these wisely and scientifically attended to, Britannia may in the coming days, as in the past, continue to rule the waves."

Annealing.

BOTH the word "annealing" and the type of operation which it describes are generally regarded as sufficiently well known and understood, in spite of the fact that a really satisfactory definition of the term is not easily framed. Engineers and metallurgists, however, are much more concerned with practical facts than with more or less abstract definitions, although at times, as in the drawing up of specifications, a precise standard definition of the terms used becomes a matter of very great practical importance. In regard to the operations generally described as "annealing," the facts themselves are by no means as fully and clearly understood as they should be, and as a result materials, and particularly steel, are at times subjected to treatment of a very undesirable character. For many purposes, where duties are light, such treatment does not matter very much, since the ill-treated material is still strong enough for its purpose and the mere fact that the part or articles is made much heavier than it need be if correct treatment could be relied upon, does not seem to matter very much. But where high efficiency of construction is important, and reduction of weight may make all the difference between failure and success, looseness of treatment becomes a serious matter. In these cases, and particularly where "ordinary" as distinct from special alloy steels are concerned, the obstacle to progress lies mainly in a failure to appreciate the value and importance of really correct heat treatment—a failure which is often shared both by the user and the producer of the steel. In comparing ordinary carbon steels with alloy steels, it is sometimes thought that there is an advantage of simplicity with the carbon steel, since the alloy steel is regarded as requiring careful heat treatment, to which the simpler material is supposed to be indifferent. Actually, correct heat treatment makes so great a difference, even to simple carbon steels, that for many purposes the use of more expensive alloy steels could be avoided if adequate care and skill were devoted to the simpler material.

Annealing is usually carried out with the object of softening steel, whether for the purpose of removing internal stresses which have been produced by the rapid cooling of large masses or complicated shapes, for undoing the hardening effect of cold work, or for removing hardness arising from rapid cooling or quenching. It is a widespread idea that for most of these purposes it is sufficient to heat the steel to some fairly "high" temperature, ranging from the dullest blood-red to a bright red heat, and to follow this heating by very slow cooling. This idea, however, is far from accurate, and leads, in many cases, to very undesirable results. Actually, the factors that affect the result are the maximum temperature reached, the time during which the steel is kept hot, and the rate of cooling. With regard to the first of these, the temperature required must depend both on the nature of the steel and the purpose of the treatment. The mere removal of internal stresses can often be effected by prolonged heating at a temperature well below a red heat, and in some cases this is a desirable method, since it can be so conducted as to avoid any material change in the internal structure of the steel. As a rule, however, the temperature used lies just on the verge of dull redness, somewhere between 600 deg. and 700 deg. Cent., and the result is a very serious softening and weakening of the steel. In terms of its microstructure, such treatment leads to a "balling up" of the carbide and the destruction of the "pearlite" constituent. It leaves the steel with mechanical properties closely resembling those of carbon-free iron, with an extremely low elastic limit and a correspondingly very low resistance to fatigue, and it is this type of annealing which often leads to subsequent failures under alternating stress or vibration. There is, as a rule, no valid reason why the annealing temperature should not be chosen so as to lie just above instead of just below the critical range of the steel, nor is there any need, except in the case of large pieces of metal, for anything other than fairly rapid cooling. If this procedure is followed, the steel is left in a stronger and more resistant condition instead of in its weakest and worst. As understanding of these matters becomes more widely spread, it may be anticipated that treatment of this type—generally known as "normalising"—will be very widely adopted. Further, where still greater refinement is needed, still better results can be obtained by first quenching the steel from a temperature above its critical range, and, except in the very mildest steels, following this treatment by a suitable tempering, such as re-heating to 600 deg. Cent. for a short time and rapidly cooling.

It may perhaps be contended that these refinements of heat treatment are too delicate, difficult and expensive for use with ordinary steels, but to this objection it may be replied that some existing processes are altogether too destructive and wasteful to be regarded as satisfactory. As an extreme case, one may take the so-called "annealing" which is sometimes given to plates and bars of mild steel in shops not provided with proper annealing furnaces—a process which consists in lighting coal or coke fires under those parts which are to be softened. This kind of treatment simply serves to spoil good material, and sometimes the steel maker is accused of supplying bad steel when in reality the material has been injured by unreasonable treatment. This kind of uneven local heating not only produces weak and soft spots, but may actually set up very heavy internal stresses, failures from which have been known to occur, even in the heavy shell plates of large boilers—a type of material to which it might surely be expected that adequately careful treatment would be given. This whole question is one which requires the careful attention of practical men, both engineers and metallurgists. Meticulous care is devoted to the question of the chemical composition of steel, and heavy expense is incurred in securing adequate purity; it is clearly worth while making sure that this pure steel is not afterwards ruined by bad treatment applied under the all-covering name of "annealing."

THE cost of the Welland Ship Canal when completed is estimated at 55,000,000 dollars. The original estimate of the cost of the canal was 50,000,000 dollars. The expenditure up to the present time has been 30,000,000 dollars.

Chinese Engineering Notes.

(From our own Correspondents.)

Peking.

Two days ago—June 3rd—President Hsu Shih Chang resigned and left Peking for Tientsin. There being no Vice-president, according to China's Constitution the duties of President devolve upon the Prime Minister, but there is no Prime Minister! Chow Tze Chi has been "Acting" Prime Minister, so he automatically becomes Acting President, and the affairs of the country are in the hands of an Administrative Council composed of the remnants of the late Cabinet, together with two new Cabinet Ministers recently appointed by the victorious General Wu Pei Fu. The whole situation is so complicated that it is difficult to imagine what is going to happen from day to day. Marshal Chang Tso Lin has withdrawn all his troops from the Province of Chihli, and is now outside the Great Wall. General Wu Pei Fu is in hot pursuit, and is reputed to have more than fifteen divisions between Tientsin and Shanhaikuan. It is not at all certain that General Wu will follow Marshal Chang beyond the Great Wall, but one thing is certain—both of these War Lords now realise that they have been tricked by ex-President Hsu Shih Chang.

It took General Wu a long time to find out what an intriguer the ex-President was, but the moment he did he gave him but a few hours to leave the Palace. Pending the assembling of the old Parliament, ex-President Li Yuan Hung has been offered the presidency, but as he realises that his nomination is a popular one he is busily engaged in making terms with General Wu's supporters. In the meantime, General Wu has installed one of his own men, Kao En Hung, as Minister of Communications, and another—Tung Kang—as Minister of Finance. Minister Kao has made an excellent start by making the people in his Ministry work. Formerly neither a Minister nor departmental head arrived at the Ministry before noon. Minister Kao has issued instructions—and so far they have been carried out—that everyone must be at his desk at 8 a.m. until noon, and from 2 p.m. until 6 p.m. By this means the new Minister hopes to be able to dispense with some 350 people, involving a saving of the equivalent of £2500 per month. Minister Kao discovered that certain officials in the Ministry held other appointments in other Ministries, and in one case an official held ten appointments and was in receipt of no less than 20,000 dols. per month. This official has lost all his ten jobs. If Minister Kao or anyone else can run the Ministry of Communications on these lines we shall soon see big changes in the financial condition of China. A sensation has been caused by the announcement that the new Minister of Finance has prepared a scheme for the appointment of a committee of foreign auditors to co-operate with his Ministry. This sounds almost too good to be true, but the fact that such an idea exists amongst a few Chinese gives one a little more hope for the future. Such reforms as are contemplated in these two Ministries, together with General Wu's determination to disband the greater part of China's army and abolish the Tuchun system, may well encourage those interested in this country, and if they can be carried out the day is not far distant when China will be financially sound, and will find no difficulty in borrowing money abroad to construct railways and develop her vast resources.

Nothing further has been heard of the Peking tramway tenders, and it looks as if—for the present, at any rate—the scheme has died a natural death. Last week a charter was granted to a group of Chinese giving it the sole right to own and operate motor omnibuses in the City of Peking. Participation to the extent of 50 per cent. has been offered to various British and American firms, but so far no denfiite arrangement has been concluded. From the outset motor omnibuses in Peking are doomed to failure. There are about 70,000 rickshaws in the city, and it is difficult enough to navigate an ordinary motor car, and would be well-nigh impossible in the case of a motor omnibus. There is not a single road in Peking, outside the Legation quarter, that would last more than a month with motor omnibuses. It is not at all certain that tramways would be a financial success. For Chinese the rickshaws are very cheap—they can go two miles for the equivalent of 1½d.—and are comfortable. They are, of course, slower, but that is of no importance here. Peking not being a Treaty Port or business city, time is of no account whatever.

Shanghai.

The political disturbances going on in China have become practically normal to this country since the first revolution of 1911, when the Manchu Government was replaced by a Republican Government, which has acted ineffectively ever since. The reason for this inefficiency is the lack of union amongst men who, having the power to make disturbances, have no ability or wish to cohere in the interest of their country as a whole. The reason for the extraordinary lack of disturbance to trade is found in the fact that the Chinese merchant takes little interest in politics, except to discuss them in the bath-house of an evening with his *confrères*, and that in a jocular way. Indeed, trade in China increases when the political situation

is most difficult, for the Chinese merchant knows that he is protected by his Government's distraction from purely domestic affairs, and, what is more extraordinary, he feels more secure in trading extensively, as he knows that at any rate his foreign trade will be protected by foreign interests, and there will be little fear of interference from his own Government.

The inquiries for foreign machinery increase apace. The importing firms are besieged with them, or were until recently, when the British importing firms had to tell their Chinese clients that the home manufacturer was unable to give prompt delivery owing to the labour troubles. The result is that with the increasing needs of the country checked by the inability of some foreign countries to supply, there is a growth of unemployment out here, and therewith some slight labour trouble also. It can be said that if one country ceases to produce other countries cease to develop, and the boomerang effect on the non-producing country as a market is inevitable. It is not as though China were not producing. She is, and more abundantly than ever, so the home troubles are acting in a particularly unfair way upon her. Here is China willing to provide work and payment for that work, and she cannot be supplied. The result will surely follow that China will tend to become self-contained in that she will manufacture for herself; but she will only be able to do so when she obtains a reliable Government, and that desirable acquisition seems to be unattainable at present. In the meantime the Customs returns are increasing, and China is progressing, and those in a position to realise the possibilities out here are preparing to cater for them.

The Canadian-Pacific Steamship Company is putting on larger and faster liners across the Pacific. The Blue Funnel Line is keeping an excellent service *viâ* Suez up to date in every way, and the other steamship lines, both across the Pacific and *viâ* Suez, are largely increasing their fleets and reducing freights, which is all for the good of trade with China. The object of these remarks is to indicate that in your correspondent's opinion the state of affairs in China might be much worse without being destructive of credit, in that business transactions with dealers out here depend for fulfilment upon the integrity of the Chinese merchant, backed by his cash guarantee, and our own prestige, rather than upon the prestige of Government authority, which, except in rare instances nowadays, is being flouted or made to do things on business lines.

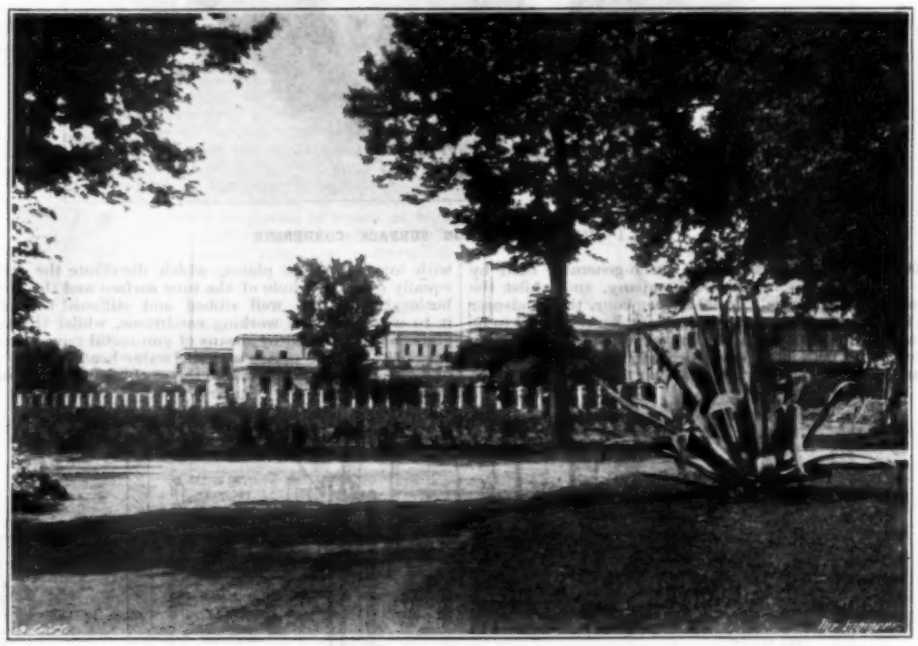
The Work of the School of Engineering, Giza, Egypt.

A DIFFICULTY that is being increasingly felt by engineering schools and colleges, as well as by other agencies for spreading technical information, is the ever widening range of specialised branches of knowledge in which instruction has to be provided. And the curriculum must be framed to meet the needs, not only of students who aim definitely at becoming aeroplane designers or works managers, naval constructors or power station superintendents, railway administrators or radio experts, but also of students who are content to gain a general familiarity with engineering principles, sufficient to fit them for whatever congenial jobs, at home or abroad, opportunity offers. In comparison with this state of affairs it is interesting to study the conditions prevailing in an institution where the technical equipment required by the student can be rigidly specified. In Egypt, a country whose existence depends on its irrigation, it is natural to find that the Government School of Engineering, at Giza, is primarily designed to train Egyptian engineers for the irrigation service of the Public Works Ministry. As the number of candidates admitted to the school is regulated by the demands of the Public Works Ministry, the student who successfully completes his course can see his future, ..ith its possibilities of promotion, just as clearly outspread before him as can the cadet of a naval or military college.

So long ago as 1834 a School of Engineering was established at Bulac, near Cairo. Twenty-one years later it was closed, but after reopening subsequently, the school was empowered in 1887 to grant diplomas. It was not until 1905 that the present school at Giza, which ranks as a Higher College under the Ministry of Education, was opened. Accommodation for 80 students was originally planned, but by the year 1916, 198 students were in attendance, and at the present time there are more than 500. At first, candidates were only accepted for the diploma in irrigation and in architecture, but since 1916 courses in mechanical engineering, electrical engineering, and municipal engineering have been available. The school is under the control of Abdel Maguid Omar Bey, M.Sc., A.M. Inst. C.E., who succeeded a year ago to the vacancy created by the retirement of the English principal. Of the staff of some forty lecturers and demonstrators, thirteen are Englishmen; many of the Egyptian lecturers have had works experience in England and have graduated in British universities. The English language is the medium of instruction for all subjects except mathematics, which is taught in Arabic.

The school premises now in use consist of three blocks, each of two stories, lying very pleasantly amid public gardens about two miles from the centre of Cairo, from which they are accessible by the electric trams running to Giza village and to the Giza pyramids. In the north block are rooms for the Principal and Vice-Principal, the administrative offices, staff common rooms, and a museum where models of irrigation appliances, bridges, &c., are exhibited. The laboratories are disposed in the south block. The test rooms contain tensile, compression, and bending testing machines of capacities of 100 tons downwards, cement testing machines, and apparatus for more elementary work on stress and strain. Adjoining is the machine shop, equipped with lathes, drilling machines, &c., and corresponding hand tackle. In the hydraulics laboratory and courtyard are centrifugal pumps in sizes up to 8in., turbines, measuring tanks and apparatus for verifying the laws governing the flow of water through pipes and channels and over notches and weirs. The electro-technics laboratory is used for experiments in general physics by first-year students, and for more advanced work in electricity by second-year students. Extending above this range of laboratories are drawing-offices occupying the whole of the upper storey.

Close to the south block is the engine-house. Here are installed a 50 horse-power Diesel engine driving a direct-current generator; a 30 horse-power "National" engine and suction gas plant, electric motors, measuring instruments and switchgear for the use of the electrical section. This electrical equipment, it may be added, includes a wireless telegraphy installation with a range of 1000 miles. The well-stocked school reference library is housed in the central block, where are also the architectural department and some lecture rooms. As most of the students need to take their mid-day meal on the premises, suitable kitchens and a dining room are provided.



THE SCHOOL BUILDINGS FROM THE GIZA GARDENS

The course of study necessary to qualify for the school's diploma extends over four years. Coming from his secondary school with some knowledge of science and mathematics, and an acquaintance with English, the student during his first two sessions at the School of Engineering continues his mathematical training and receives instruction in applied science, machine construction, workshop practice, and elementary surveying. The last two years of the course are more specialised—irrigation students naturally concentrate more on subjects such as hydraulics and irrigation design, theory of structures and geology. It will have been gathered from the description of the school buildings that generous provision is made for laboratory and drawing-office work during all stages of the course. The diploma examinations are conducted by engineers from the appropriate public department, ensuring that the instruction given is kept closely in touch with actual needs. Continuous efforts are made to raise the standard of work, which already approaches that prevailing in some English universities; the success attained can be gauged by noting one or two of the exercises completed this year by fourth-year students. The entire design of a Scherzer rolling lift bridge has been worked out, and detailed drawings made of the girders and flooring, masonry, and hand operating gear. As part of the final examination the carrying through of a "project" is set, a map of a tract of country being provided which it is desired to irrigate in a specified manner. It is left to the student to fix the alignment of the irrigation canals, design dams and weirs for the storage reservoir, and work out details of the necessary regulating appliances.

An excellent system is now being initiated whereby the lectures of the resident staff are supplemented by courses of lectures in which officials of the Public Works Ministry describe the works on which they are actually engaged. In this way the results of the valuable researches that are constantly going on are put immediately at the disposal of the men most likely to profit by them, and who are thus prepared in their turn to carry on the work. Every student is given opportunities of becoming personally familiar with the conditions of his future work. During his summer vacation at the end of the third year he is sent for some weeks to assist in practical irrigation duties in Cairo or the provinces; in the following winter vacation in February, he is taken on a round of visits to all important centres between Cairo and Assuan. At each centre the local problems and peculiarities are fully explained by the engineers in charge, so that the student acquires an extremely useful fund of first-hand information about the working of the Assuan dam and reservoir, the Esna and Assiut barrages, the big pumping stations at Kom Ombo and Korimat, and of the canal systems in the Nile valley and in the Fayoum. Some days are also spent at the Delta barrage, where actual measurements are made of the discharge of the Nile and of the main canals that take off at the barrage. As an additional incentive to purposeful study, students who take high places in the diploma examination are given the option of going "on mission" to England, where arrangements are made for them to have practical experience in workshops. This privilege, of course, is especially valuable to those taking mechanical or electrical courses, there being little opportunity in Egypt of learning the details of modern engineering manufacturing. It will be conceded that little else could possibly be done for the students of the School of Engineering to fit them for effective work in their profession. Even the challenge and inspiration of the most mighty and ancient feats of engineering are not lacking; only a few miles away there rise, pale against the morning mist and dark against the afternoon sun, the pyramids of Giza.

BOOKS RECEIVED.

Jigs, Tools and Fixtures: Their Drawing and Design. By Philip Gates. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 8s. 6d. net.

Notes Economiques d'un Métallurgiste. By Camille Cavallier. Paris (6e): Gauthier-Villars et Cie., Imprimeurs-Editeurs, 55, Quai des Grands-Augustins. Price 3f. 50c.

Empire Forestry. Journal of the Empire Forestry Association, Imperial Institute, London. Vol. i., March, 1922. Published quarterly. London: Macmillan and Co., Limited, St. Martin's-street, W.C. 2. Price 4s. net, 1 dol.

Anglo-South American Handbook for 1922, *including Central America, Mexico* and *Cuba.* Edited by W. H. Koebel, for the Federation of British Industries. London: T. Fisher Unwin, Limited, 1, Adelphi-terrace, W.C. 2. Price 25s. net.

British Standard Specification for Materials and Constructional Strength of Chemical Fire Extinguishers. London: The Offices of the British Engineering Standards Association, 28, Victoria-street, London, S.W. 1. Price 1s. 2d. post free.

Working of Dynamos and Electric Motors. A series of notes on the care, working and maintenance of dynamos and electric motors. Manchester: The National Boiler and General Insurance Company, Limited, National Buildings, St. Mary's Parsonage. Price 1s. 6d.

Surface Condensing Plant.

To the order of the Glasgow Corporation Tramways Department, the Mirrlees Watson Company, of Glasgow, is installing an interesting surface condensing plant in the Pinkston power station, where three other Mirrlees condensers have also been erected. The new plant, which is shown in Figs. 1 and 2, is to work in conjunction with a

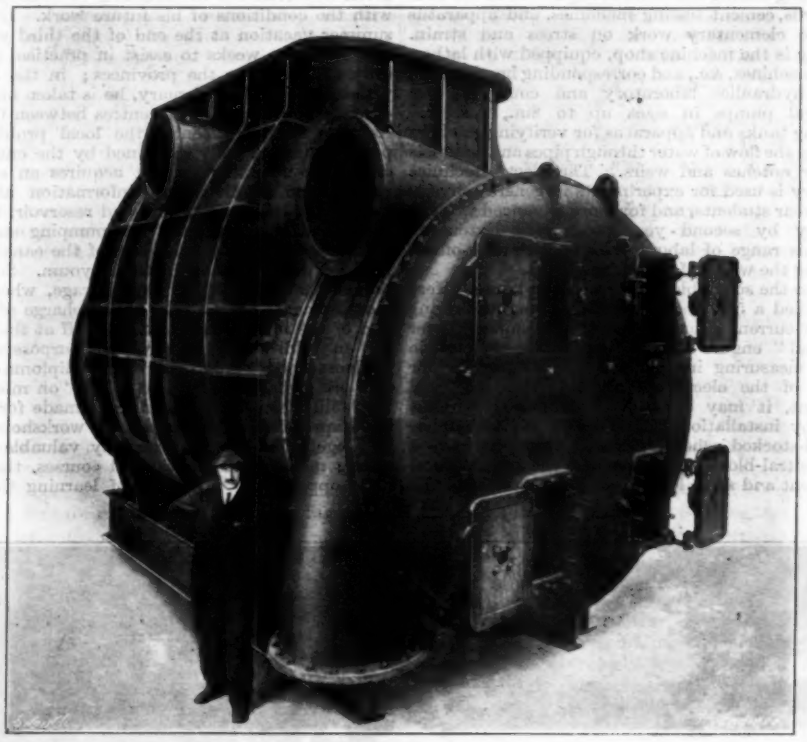


FIG. 1—MIRRLEES WATSON SURFACE CONDENSER

10,000-kilowatt 1500-revolution turbo-generator built by the British Thomson-Houston Company, and whilst the normal steam duty is 125,000 lb. per hour, the condenser has been designed to cope with a heavy overload and to be capable of maintaining a vacuum of 27.8in., with cooling water at 75 deg. Fah. when dealing with 185,000 lb. of steam per hour. At normal full load the plant is guaranteed to give a vacuum of 28.3in. with circulating water passing through the tubes at the rate of 19,200 gallons per minute. A cooling surface of 19,000 square feet is provided by solid drawn brass tubes which are $\frac{7}{8}$in. in diameter and 18 S.W.G. thick, the brass being a mixture of 70 per cent. copper, 29 per cent. zinc, and 1 per cent. tin. At both ends the tubes are held in position and kept tight by screwed ferrules and packings. The velocity of the water through the tubes is 6.1ft. per second, and the rate of heat transmission is practically 630 B.Th.U. per degree Fahrenheit difference of temperature.

The condenser shell, which is composed of cast iron, is 10ft. in diameter, and is designed to provide two passes for the water, and to operate on the counter-flow principle. The length between the tube plates is 13ft. 7in. With a view to ensuring that the stresses are equally distributed over the whole surface of the tubes, the steam distributing box, which is of large capacity, is provided with internal guide plates, which distribute the steam equally over the whole of the tube surface and the distributing box. It is well ribbed and stiffened to enable it to withstand the working conditions, whilst the tube plates are supported by means of gun-metal tension stays between the tube plates and the water head covers. To provide adequate resistance to the working water pressure, the circulating water division plates in the end covers are corrugated and as far as possible a stream-line effect is produced in the inlet and outlet water connections.

From the drawing—Fig. 3—the general design of the condenser will readily be understood. The progressive pitching of the tube sections, as shown in the cross section of the drawing, is a feature to which the makers direct particular attention. The top tube sections have a very open pitch, and the tubes are arranged in rows parallel with the direction of the steam flow, an arrangement which allows of large area and minimum resistance to the flow of steam into the heart of the condenser. The lower nests of tubes have a decreasing pitch and diagonal spacing, the complete effect of the design of the steam distributing box and spacing of the tubes being that practically every tube does its share of condensation and with a minimum loss of vacuum between the steam entry and air suction branch. In the last section of the tubes, namely, those situated in the first water pass, there is a de-vaporising chamber, which encloses a certain percentage of the tubes within a galvanised mild steel baffle which extends the full length of the condenser and has openings at each end adjacent to the tube plates. Together with a certain amount of vapour the air finally passes through this de-vaporising chamber in which a portion of the vapour is condensed and the air is cooled, so that the amount of mixture which the air pump has to deal with is reduced to a minimum. In order that all the tubes in the condenser may be readily inspected, the end covers are provided with hinged inspection doors which are staggered and the dimensions of the doors are sufficiently large to enable a man to enter the water head and re-pack the tubes or examine their condition.

As the circulating water leaves a deposit of sediment and slime on the tubes, the condenser has been fitted with a Mirrlees patented tube-cleaning apparatus, as illustrated in Fig. 4. The apparatus consists of a small ejector and a piping system, and it is so designed that the cleaning fluid can easily be introduced into the condenser and controlled. The solution is caused to circulate in the condenser by the action of the ejector, which also heats up the solution and any scale or greasy, muddy deposit is quickly and thoroughly removed. At Pinkston the cleaning agent used is a 1 per cent. solution of commercial caustic soda, and the method of operation is as follows:—Having closed the circulating water valves and opened the air cocks on top of the water heads, the condenser is filled with clean water. The air cocks are then closed and the valves E and D—shown in Fig. 4—are opened. On admitting steam to the ejector A, the water in the upper part of the condenser is drawn through the bell-mouthed orifice G into the cleaning apparatus, and on passing down to the ejector is discharged through the perforated cone F into the lower part of the condenser, the water being at the same time heated by the steam from the ejector.

When the circulation is thus established a quantity of cleaning fluid sufficient to give the required strength of solution is poured into the funnel B, and on opening the cock C this cleaning fluid is drawn in and mixed with the hot water circulating in the condenser. A dirty condenser can be cleaned in a period of from six to eight hours, but with frequent periodical cleaning the operation will only occupy a little over an hour. Condensers cleaned in accordance with this method are said to maintain a high efficiency. The strength of the solution must not, however, be allowed to exceed certain prescribed limits, and the temperature must be kept within a maximum of 150 deg. Fah. by occasionally shutting down the ejector. When the cleaning operation has been completed and the liquid has been drained or pumped out, the condenser is thoroughly washed out with clean water. When the deposit forms a hard scale a weak solution of hydrochloric acid is used instead of caustic soda, and after the cleaning has been done the condenser then has to be washed out with an alkaline solution.

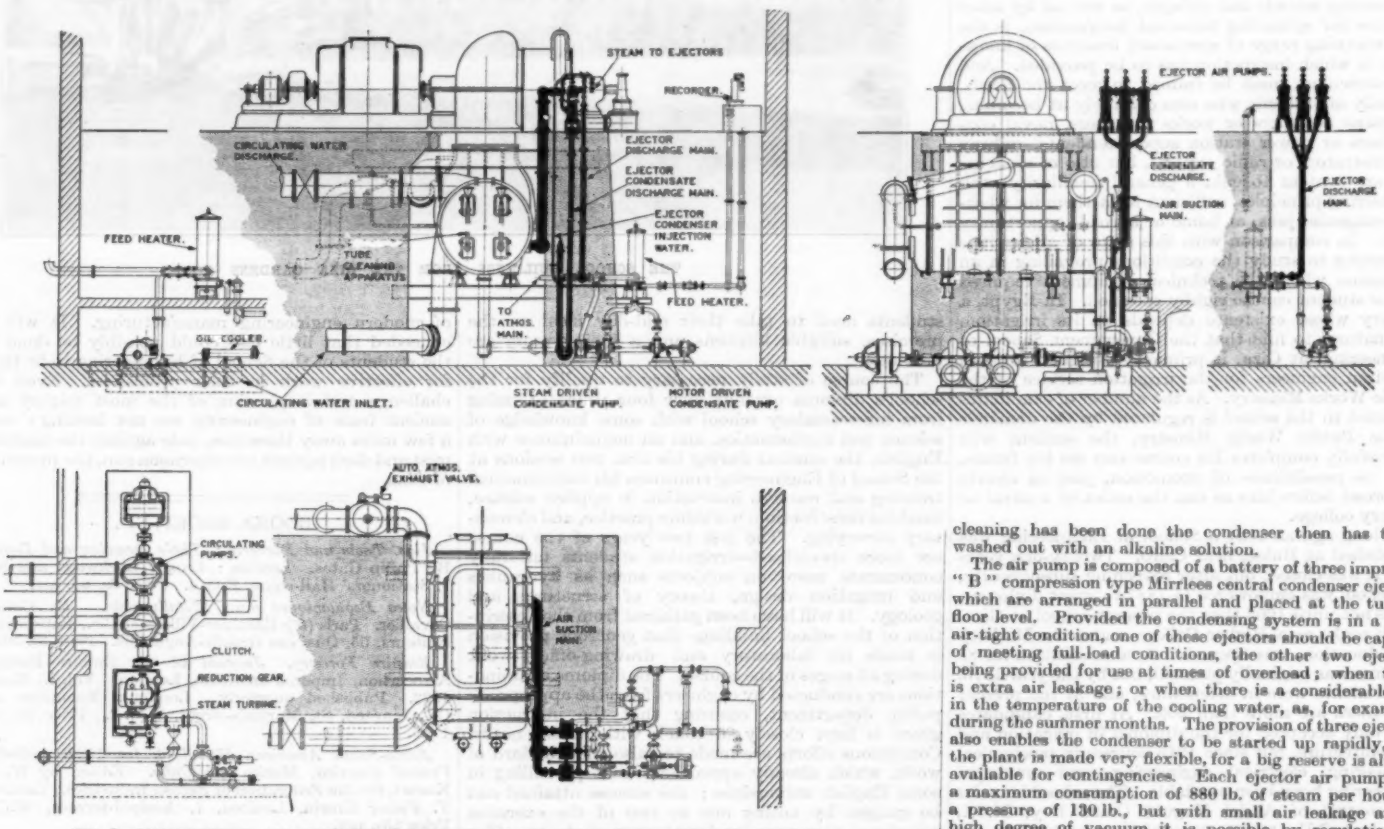


FIG. 2—ARRANGEMENT OF SURFACE CONDENSING PLANT AT PINKSTON POWER STATION

The air pump is composed of a battery of three improved "B" compression type Mirrlees central condenser ejectors which are arranged in parallel and placed at the turbine floor level. Provided the condensing system is in a good air-tight condition, one of these ejectors should be capable of meeting full-load conditions, the other two ejectors being provided for use at times of overload; when there is extra air leakage; or when there is a considerable rise in the temperature of the cooling water, as, for example, during the summer months. The provision of three ejectors also enables the condenser to be started up rapidly, and the plant is made very flexible, for a big reserve is always available for contingencies. Each ejector air pump has a maximum consumption of 880 lb. of steam per hour at a pressure of 130 lb., but with small air leakage and a high degree of vacuum it is possible by regulation to reduce the consumption to about 600 lb. The curve—Fig. 5—shows the vacuum obtainable with different cooling water temperatures.

There are two Mirrlees centrifugal condensate pumps of the double-entry type and designed to work with a minimum head on the suction side of 18in. With the normal condenser vacuum each pump is capable of dealing with the whole of the condensate at the maximum overload, and will deliver the condensate through a surface heater and a Lea recorder against a manometric head of

30ft. The speed of the pumps is 1440 revolutions per minute. One of them is driven by a British Thomson-Houston two-stage impulse turbine through single-reduction gearing having a ratio of 2.5 : 1, whilst the second is directly coupled to a direct-current motor rated at 14 brake horse-power and working at a pressure of 550 volts. Both the pumps are fitted with rustless steel shafts. The circulating water pump is composed of two units arranged to run in parallel, and each unit is designed to deal with 19,200 gallons of water per minute, and to deliver the water against a manometric head of 23ft. when running at a speed of 500 revolutions per minute. The pumps are mounted on a common bed-plate, thus forming one compact unit, and they are driven at one end by a steam turbine, and at the other end by a direct-current motor. The former is used for starting purposes only when no current is available, a clutch being incorporated between the turbine and pump so that the motor-driven pump may be used for normal running. The two-stage turbine is rated at 185 horse-power, and it drives the pump through single-reduction gearing with a ratio of 7.2 to 1. Owing to the level at which the pumps are placed they are always submerged, and they take the water from the Forth and Clyde Canal. Both pumps are therefore self-priming. The 24in. suction pipe is duplicated. Separate surface feed-water heaters are provided to deal with the exhaust from the condensers in one case, and from the auxiliary turbine in the other case.

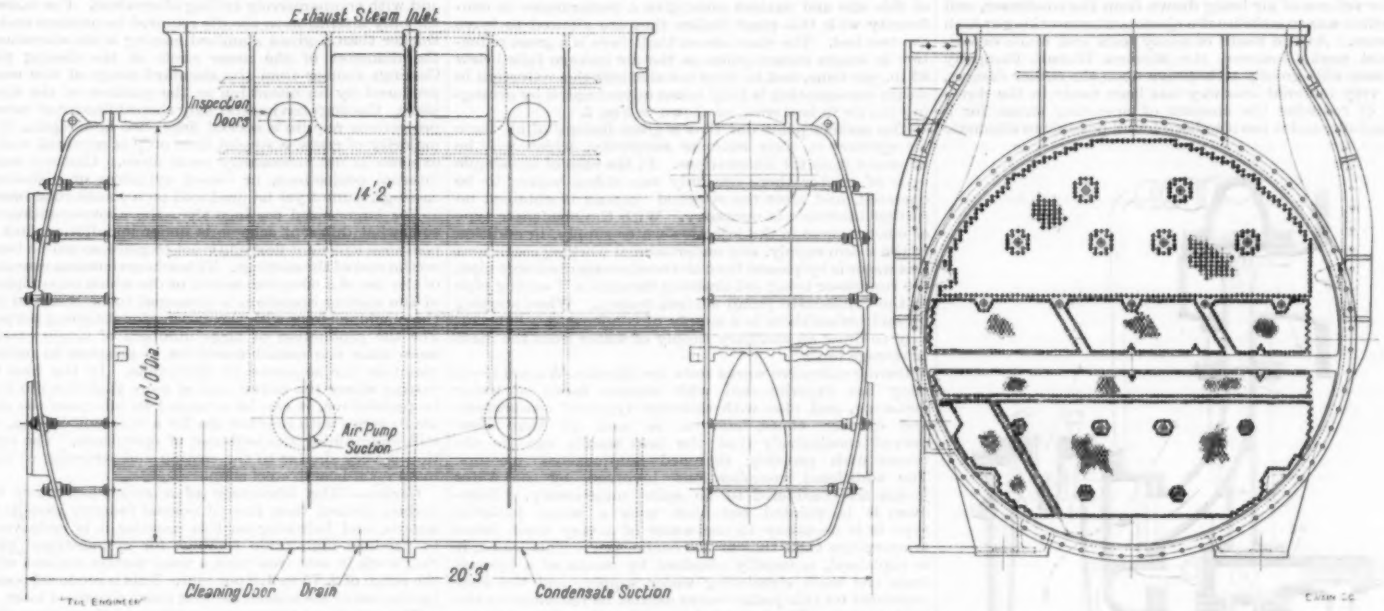


FIG. 3—LONGITUDINAL AND CROSS SECTION OF MIRRLEES WATSON SURFACE CONDENSER

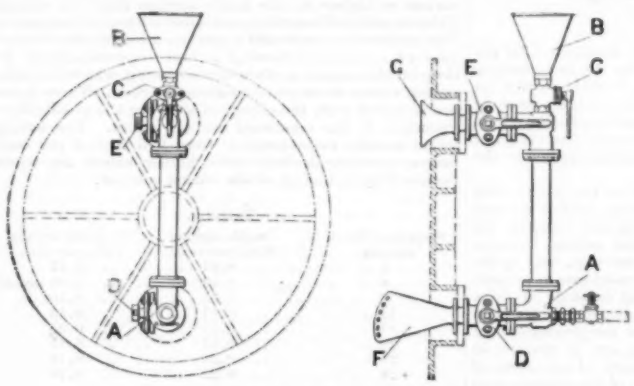


FIG. 4—TUBE CLEANING APPARATUS

The manufacture of steam air ejector pumps was taken up by the Mirrlees Watson Company, Limited, in 1914, when a licence was arranged with the Westinghouse Leblanc Company, of Paris. Two types of ejector air pumps were developed, a type consisting of two ejectors working in series, as shown in Fig. 7, and the condenser type, as shown in Fig. 8. In the former case there are two compression stages, each of which is controlled by a group of steam nozzles operating in series. Each stage comprises a steam chest, as shown at A and A_2, an air suction chamber B, B_2, a group of convergent-divergent steam nozzles C, C_2, and a convergent-divergent compression pipe D, D_2, terminating in a diffusion pipe E, E_2. The air inlet branch F is connected to the condenser or other arrangement from which air has to be withdrawn, and the operating steam supply pipe is connected to the main inlet G arranged on the second-stage steam chest, whilst a branch pipe H, fitted with a stop valve, conveys a supply of steam to the first-stage nozzles.

The operation of these ejectors depends, of course, upon the projection of steam at high velocity through the multiple nozzles into the compression pipe, the first-stage group of nozzles C giving the initial motion to the air and gases which are partially compressed in the first-stage ejector, and as they flow through the second stage they attain considerable velocity, the final velocity being imparted by the second-stage group of nozzles C_2. On passing through the second-stage compression pipe D_2, the mixture enters the diffuser pipe E_2, where the kinetic energy is transformed into useful work in overcoming the atmospheric pressure at the discharge end J.

The condenser type of ejector—shown in Fig. 8—is similar to the simple form of ejector just described, but a small condenser is fitted between the two compression stages, and the air and gases from the first stage are discharged through the diverted diffuser pipe E into the jet condenser at K. The steam used for the first-stage ejector is condensed by the water spray issuing from the nozzle L, and the injection water and condensed steam are drained from the condenser at N. The cooled air and incondensible gases are withdrawn through the passage M by the second-stage ejector, and the mixture passes through the compression pipe D_2 and enters the pipe E_2 where the kinetic energy is transformed into useful work in overcoming the atmospheric pressure. In the earlier ejector air pumps an auxiliary air inlet was provided at the throat of the second-stage ejector, as illustrated at K in Fig. 7, the reason for this being that, if the ejectors were designed to pass only that amount of air which would be necessary during normal working under full vacuum, the throat area would be too small when starting up; that is to say, when the ejector is engaged in exhausting the condenser and turbine of the large volume of air at atmospheric pressure.

In order to hasten the building up of the vacuum, the throat of the second-stage ejector was made larger than necessary for normal working, and the auxiliary inlet illustrated was therefore provided. As soon as the volume of the air coming from the condenser dropped below that necessary to fill the throat, a certain vacuum occurred

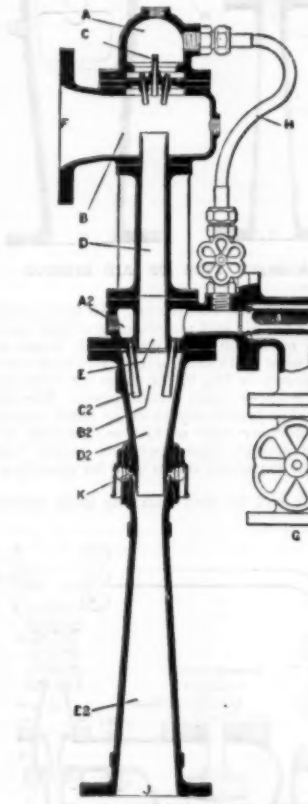


FIG. 7—TWO-STAGE AIR EJECTOR

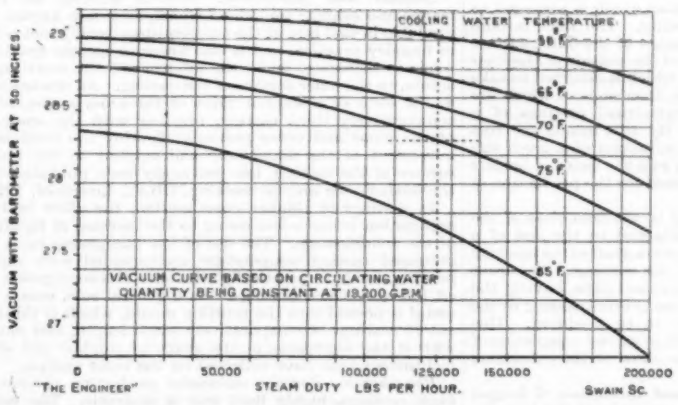


FIG. 5—VACUA OBTAINED WITH DIFFERENT COOLING WATER TEMPERATURES

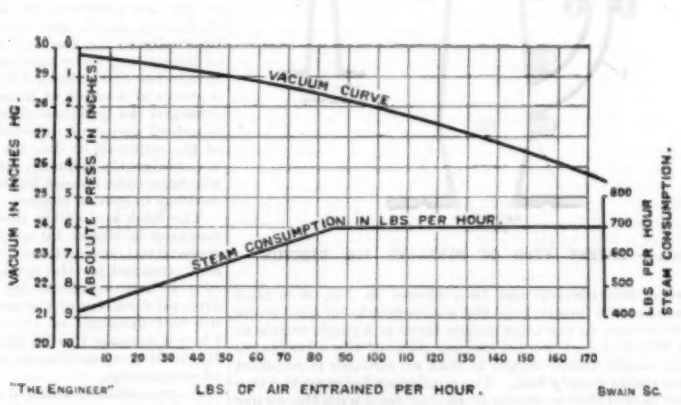

VACUUM CURVE
STEAM CONSUMPTION IN LBS. PER HOUR.
VACUUM IN INCHES HG.
ABSOLUTE PRESS IN INCHES.
LBS PER HOUR STEAM CONSUMPTION.
30 29 28 27 26 25 24 23 22 21 20
0 1 2 3 4 5 6 7 8 9 10
800 700 600 500 400
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170
"The Engineer"
LBS. OF AIR ENTRAINED PER HOUR.
Swain Sc.

FIG. 6—STANDARD WORKS TEST CHART

at this point, and the air from the atmosphere passed through the ports provided. The amount of auxiliary air passing in depended upon and was inversely proportional to the volume of air being drawn from the condenser, and the effect was to stabilise the ejectors when working at high vacuum. As the result of many tests and much experimental work, however, the Mirrlees Watson Company has been able greatly to improve upon the earlier designs, and very material headway has been made in the direction of reducing the amount of operating steam for a given duty, and it has also been found possible to eliminate

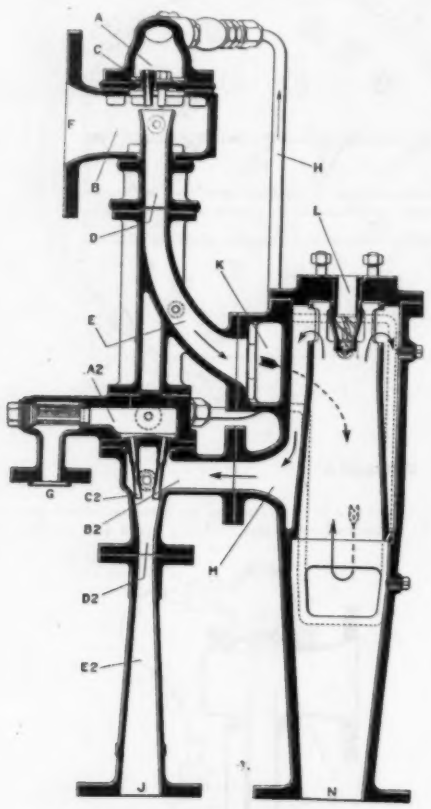


FIG. 8—CONDENSER TYPE OF AIR EJECTOR

the auxiliary air inlet just mentioned. So far as dealing with large volumes of air and maintaining a high vacuum and stability of operation were concerned, those early types of ejectors were quite satisfactory, but with the new condenser type shown in Fig. 9, the same air duty can be maintained with a lower steam consumption. The simple type of ejector takes practically twice as much operating steam as the condenser type of ejector, because in the former case the second-stage operating steam has to re-compress all the expanded steam used for operating the first stage.

From Fig. 9 it will be seen that the main difference

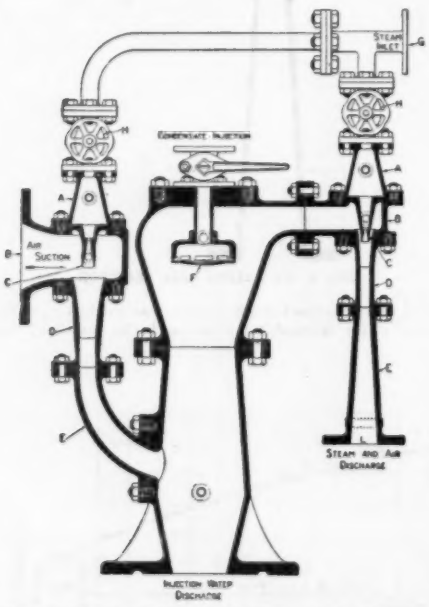


FIG. 9—LATEST TYPE OF MIRRLEES AIR EJECTOR

between this ejector and that shown in Fig. 8 is that whereas in the former type the steam nozzles of each stage are in groups, in the later design there is a single nozzle in both the first and second stages. One of the advantages of the single nozzle design is that no strainer is required in the steam supply box. The condenser between the two stages is of different design from that used with the earlier ejectors, and is rather more efficient. The reduction in the amount of operating steam, however, is attributable to the particular design, shape and dimensions of the steam nozzles and the convergent and divergent steam cones or tubes. A standard works test chart for one size of ejector of the latest type is shown in Fig. 6, the maximum steam consumption for this ejector, which is built upon the principle shown in Fig. 9, being 700 lb. per hour. All ejectors of this size and pattern must give a performance in conformity with this chart before they are allowed to leave the test bed. The chart shows that there is a great reduction in steam consumption as the air leakage falls below 85 lb. per hour, and in large installations this reduction in steam consumption is fully taken advantage of by arranging the air in batteries, as shown in Fig. 2.

The makers point out that a great feature of all these air ejectors is their extreme simplicity, which will be apparent from the illustrations. In the case of the simple type of ejector there are only two steam valves to be operated, and after the required vacuum is obtained no further attention is necessary. With the condenser type of ejector there is the injection water supply, in addition to the steam supply, and under normal working conditions this water is by-passed from the condensate discharge pipe, the condenser being self-draining through a U sealing pipe to the condensate pump suction branch. When starting up and before there is a supply of condensate it is necessary to draw an auxiliary supply of water from the main or storage tank.

During extensive works tests the Mirrlees Watson Company has experimented with various forms of water jacketing, and also with different types of compression and diffuser cones, and it is said to have been proved conclusively that the best results can be obtained with properly designed non-jacketed ejectors. The additional complications involved by the water jacket are considered to be quite unnecessary. Moreover, it is pointed out that with a water jacketed type it is necessary to use water of a very much lower temperature than that of the condensate. This water, it is explained, is usually obtained by means of a by-pass from the main circulating water supply, and the heat expended on this jacket water cannot be recovered in the feed water. Tests carried out by the firm do not confirm the claim that the water jacket enables isothermal compression to be obtained, instead of adiabatic compression. It has been said that without water jacketing there is a danger of the convergent cone becoming hot and consequently putting the ejector out of action, and also resulting in a very high temperature of the discharged steam and gases, but this does not, we are told, apply to the Mirrlees ejectors, for the convergent cone is quite cool, and the discharged air and gases do not attain a temperature higher than 215 deg. Fah.

Centrifugal Castings.

By F. E. HURST.*

A CONSIDERABLE amount of interest is attached to the method of the production of castings by the introduction of molten metal into rapidly rotating moulds carried on specially designed machines, a process which has now come to be well known as the centrifugal casting process. It is the author's intention to deal in a somewhat brief manner with certain of the aspects of this process as applied to the production of cast iron castings.

The process, as at present operated in the works with which the author is connected,† is being applied to cast iron for the purpose of producing large-size castings for piston ring sleeves, gas, oil and Diesel engine cylinder liners, chilled wheel and chilled roll castings, and cylindrical castings of all descriptions. The machines at present in operation are capable of producing castings up to a maximum length of 36in., and of varying diameters from 10in. up to 30in. Other machines for the production of both smaller and larger-sized castings are at present in the course of construction. The principle of operation of the centrifugal casting process consists of the introduction of molten metal into the mould or die which is rapidly rotating about a horizontal axis. For cylindrical articles no core is used, and a perfectly cylindrical interior surface is produced direct by virtue of the centrifugal force under which the metal solidifies and the rate of introduction of the metal into the mould. Castings other than chilled castings are produced at the author's works, directly machinable, a feature which is arrived at by strict control of the chemical composition of the metal and the details of the mould and casting operation.

The machine consists essentially of a face-plate mounted on a shaft carried in bearings arranged to be rotated at the required speeds. The moulds are attached to the face plate by bolts, and when rotating the molten metal is introduced by tilting a specially designed pourer which has been moved into position inside the rotating mould.

The moulds themselves are constructed in two parts, viz., an outer holding casting which is arranged to bolt to the face plate and an inner liner which is arranged to fit loosely inside the holder casting. The liner is bore internally to the size and dimensions of the outer surface of the casting to be produced, and the outside of the liner is bored to fit the holder casting, which is designed to take a group of a series of liners, the dimensions of which are arranged to produce flanged cylindrical castings of a standard series of dimensions. By this means the cost of the renewals of dies for the production of a given size is considerably reduced, and as a rule the series of holders will take most special liners required for the production of castings of special shapes.

The back end of the liner next to the face plate of the machine is closed by a plate attached to the end of a screwed rod passing through the hollow shaft of the machine and arranged for the ejection of the castings. The front of the liner is closed by an annular plate having the internal diameter of the annular ring corresponding to the internal diameter of the casting to be produced. This plate is arranged to be removable after the completion of the casting operation in order to allow of the extraction of the casting.

As indicated, a series of standard dimensions of flanged cylindrical castings has been drawn up, and the installation of the necessary holders and liners to produce these, makes it possible to produce a wide variety of cylindrical castings within the limits of dimensions mentioned above and with comparatively trifling alterations. For example, the only alteration to the die required to produce castings thicker than a given standard casting is an alteration to the diameter of the inner circle of the closing plate. Castings shorter than the standard range of size can be produced by an alteration in the position of the ejector plate. Castings having specially shaped flanges or external projections require a special liner, but here again, in the majority of cases, a special liner only is required, and the expense is not necessarily prohibitive. Castings having internal projections, or closed cylinders or dish-shaped castings, cannot yet be produced on a commercial basis.

For larger-sized castings than the above-mentioned, a somewhat different scheme is under installation, but this possesses sufficient flexibility not to place an undue burden on the cost of the castings. This scheme consists essentially of the use of a complete mould or die which on completion of the casting operation is arranged to be removed from the machine along with the casting for stripping purposes. For the production of large numbers of single castings, more than one mould would be in progress in order to maintain the sequence of operations. In the case of a casting where the initial cost of more than one die would be prohibitive, it can be arranged to interpose the single die in series with another die for a different casting, thus still maintaining the sequence of operations. The operation is very similar to the casting and stripping of ingots in an open-hearth steel shop.

Carbon.—The advantage of a somewhat lower total carbon content than that of normal foundry irons is well known, and following on this practice, it is endeavoured to produce high-grade castings for cylinder and piston ring work in cast iron with a total carbon content within the range of 2.75 to 3.0 per cent. This is rendered possible by the use of the special melting plant described later.

The combined carbon, on account of the higher silicon content usually worked to, is lower than what is usually obtained in ordinary foundry practice. This is advantageous in castings such as piston rings and the like which are subject to comparatively high temperature conditions. A series of figures given below—Table I.—show that the variations in combined carbon within the limits of the figures given have practically no influence on the tensile strength value. Starting with a cold mould at normal temperature, the first few castings are invariably chilled on the outer surface or the surface next to the metal mould. As the temperature of the mould rises, the chilled surface on the castings rapidly disappears, and the combined carbon gradually reaches a constant value. The figures given in Table I. serve to show the variation in combined carbon with the order of casting. The remarkable feature of this series of figures is that the combined carbon is higher on the inside surface than the outside. This is worthy of recording and is met with quite frequently. The author has preserved a specimen for future examination of a casting showing a layer approximately ¼in. deep on the outside surface of the casting, which on examination shows no trace of combined carbon. These figures are included with the object of showing the possibility of variation in the combined carbon values. The average value usually maintained is from 0.3 to 0.5 per cent., unless specially desired, when higher values are readily obtained by reduction of the silicon content.

TABLE I.

Sequence No. of casting.	Inside surface C.C., per cent.	Outside surface C.C., per cent.
1	0.66	0.47
4	0.49	0.00 (trace)
8	0.55	0.10
12	0.17	0.15
16	0.42	0.05
20	0.22	0.15
24	0.24	0.14
28	0.22	0.14

The proportion of graphite present naturally varies with the combined carbon, and in this connection it is of considerable interest to record that no case has yet been met of any segregation of the graphite during the casting process. This is strong confirmatory evidence that in cast iron below and up to the eutectic composition the graphite does not form in the liquid state, and is formed quite late in the solidification range. If the contrary were the case, then one would certainly expect to find some indication of the segregation of the graphite to the inner surface of the casting, particularly in view of the wide disparity in the specific gravities of graphite and iron.

Silicon.—The average value of the silicon in centrifugal castings is about 2.75 per cent. This is a somewhat higher value than is usually used in sand-casting practice for high-grade work. Lower value than this can be cast.

Sulphur and Manganese.—Sulphur existing as the manganese sulphur compound which, as is now known, is insoluble in cast iron at the temperatures usually met with in foundry practice, and is also lower in specific gravity, tends to segregate, under the influence of the centrifugal action, to the inner surface of the casting. An illustration in the form of a sulphur print of the cross section of a comparatively thick casting, together with the analysis of the inner and outer portions, showing the combined movement of the manganese and sulphur to the inner surface of the casting, has previously been published by the author—see annual meeting, I.B.F., Liverpool, 1920.

In castings of thinner cross section, the effect of the segregation is much less owing to the increase in rapidity of the solidification. The use of low manganese irons or increased casting temperature accompanied with rapid pouring, tends to practically eliminate this segregation in all but very thick castings. As a general rule, excess of metal is poured into the rotating mould, which is thrown out in castings of comparatively small length, and along with it the segregates in the shape of sulphur and slag inclusions which have collected on the inner surface.

Phosphorus.—For the successful production of centrifugal castings, highly fluid iron is desirable. The well-known effect of phosphorus on this property would appear to be of considerable value in this process. Unfortunately, the influence of phosphorus on the properties of centrifugal cast iron appears to be very undesirable, and in so far as our investigations have gone it is largely to that element

* From a paper read before the West of Scotland Iron and Steel Institute on January 20th, 1922, and published in the *Journal* of the Institute.

† Centrifugal Castings, Limited, Kilmarnock.

that low tenacity and, what is more serious, "brittleness" in centrifugal castings, is to be attributed. This particularly appears to be the case when the phosphorus is present in conjunction with fairly high silicon values. For high-grade castings, therefore, on this account only, low phosphorus material is desirable, and a maximum of 0.60 per cent. for special castings is now worked to. This is obtained by the use of steel scrap or hematite, preferably the former, and the necessary fluidity, and incidentally uniformity, is obtained by maintaining a high casting temperature in the melting plant specially designed for this purpose. Before leaving the question of phosphorus, it is of interest to mention a curious tendency noticed on several occasions for the phosphorus to segregate to the outside surface of the castings. This the author believes is worth recording, as a similar tendency has been noticed in the case of the eutectic in the die casting of copper aluminium alloys.

The composition of some of the different articles recently made on the centrifugal casting machines are included in Table II. These figures are included with the object of giving some idea of the range of composition which can be satisfactorily dealt with by this process.

TABLE II.—*Direct Tensile Tests on Centrifugal Iron Castings.*

No.	Tot. C. p.c.	Si. p.c.	Mn. p.c.	S. p.c.	P. p.c.	Ultimate strength. Tons per sq. in.
1*	3.21	2.75	0.31	0.11	0.64	17.46
2†	2.99	2.70	0.39	0.09	0.64	19.40
3†	2.95	2.85	0.28	0.10	0.92	19.95
4‡	2.99	1.98	0.35	—	—	19.50
5‡	3.10	2.55	0.29	—	—	19.31
6‡	3.15	2.75	0.29	—	—	18.71

* Direct cupola melted. † Metal from receiver. ‡ Determined on ring.

The cast iron containing nickel and chromium is being used for the production of the chilled iron wheels previously mentioned and illustrated. The author is yet unable to give data of the physical properties of this material as centrifugally cast, and its use for this purpose has suggested itself on the basis of certain stationary chill casting experiments, of which the author has had previous experience. The main object in using this material is the desirability of producing a chill having an extremely close grain, as distinct from the somewhat coarser grain of plain cast irons. The composition is at present being obtained by melting nickel chrome steel scrap in the mixture.

Physical and Mechanical Properties of Centrifugal Castings.—It is necessary to point out that the consideration of the mechanical properties of centrifugal castings should always be made in conjunction with the chemical composition, and this must be taken into consideration when making comparisons between centrifugal and sand castings. So far as the investigation of the properties of centrifugal cast iron has gone at present, in all cases a distinct improvement in the mechanical properties has been found. An improvement would, of course, be expected on the grounds of the use of a metal mould, although there is no doubt that the centrifugal method itself has considerable influence in modifying the properties of the cast iron.

The figures given in Table II. are the results of tensile strength determinations on bars and rings cut from centrifugal castings of the compositions given in the table. This collection of results serves to show the influence of the reduction in total carbon content in increasing the tensile strength and the slight falling off in strength with increased silicon content. In all cases it will be agreed that the values are slightly higher than would be obtained from sand castings of identical composition. The tensile test specimens were in all cases machined from the castings, and where the method of determination is stated as direct, the test piece was machined up in the ordinary form and broken in the usual manner. In those cases where the determination was made on rings, the procedure recommended in British Engineering Standards Specification 2 K. 6, was followed, using the formula set out therein for obtaining the breaking load per square inch of section. The results of some determinations of the resistance to wear determined by the use of a special machine designed by the author are given in the following table—Table III.

TABLE III.

Centrifugally Cast Metal.

	Grains.	Loss, grains.
Original weight of specimen ..	6.7500	
Weight after 3,000,000 revs. ..	6.7349	.0151
" " 4,000,000 " ..	6.7339	.0010
" " 5,000,000 " ..	6.7335	.0004
" " 7,000,000 " ..	6.7331	.0004
Total loss ..	—	.0169

Sand Cast.

	Grains.	Loss, grains.
Original weight of specimen ..	6.7530	
Weight after 3,000,000 revs. ..	6.7455	.0075
" " 4,000,000 " ..	6.7425	.0030
" " 5,000,000 " ..	6.7325	.0100
" " 7,000,000 " ..	6.7220	.0105
Total loss	—	.0310

Both samples tested were of the same composition and from the same cast. The sand cast specimens were prepared from standard ½in. diameter round bars, and the centrifugal-cast specimens were machined from cylindrical castings having a wall thickness of approximately ½in. The tests were made under strictly comparable conditions, and the extent of the wear in each specimen, as indicated by the loss in weight, is given in the table. These figures are the only long series that the author has yet available, and are taken on a material having a fairly high silicon content as indicated. The state of our knowledge of the factors governing wear in materials is insufficient to allow of the broad conclusion that these results are characteristic of centrifugal castings, and they are included merely as the results of a long comparative test. The figures in themselves are rather remarkable, indicating as they do a greater loss in weight in the centrifugal casting of the above composition in the earlier stages of the test. The magnitude of this loss in weight in the centrifugal casting decreases as the test is prolonged, and has apparently reached a constant value, whereas in the sand casting the loss in weight increases steadily with the prolongation of the test. It is also worthy of notice that the combined carbon in the sand-cast specimen is higher than in the centrifugal-cast material. Investigations are being made as the opportunity occurs into the behaviour of centrifugally cast material under the influence of high-temperature conditions on the elastic properties and other properties of interest in connection with high-grade castings. As in the case of sand castings, the composition of the material has a profound influence on all these properties, apart entirely from any influence of the method of casting, and up to the present time the tests made are more or less of an exploratory nature, with a view to indicating the most hopeful lines to work on. The data yet available are of too disjointed a nature for publication.

Structure of Centrifugal Castings.—The freshly broken fracture of centrifugal castings in cast iron is invariably very close grained. Neglecting a thin layer on the outside edge of the casting adjacent to the metal die, the fracture of the centrifugal castings produced under correct conditions is uniform throughout. The uniformity of the fracture is particularly noticeable in castings of comparatively large cross-sectional area.

Beyond showing the reduction in size of the graphite, the author has not been able to show clearly the reduction in size of the grains corresponding with the evidence obtained by visual examination of the fracture. In certain experiments which have been made on non-ferrous alloys the grain size can be readily shown by modified etching methods. The author considers it legitimate to make the deduction that the grain size of cast iron is similarly effected. There is no doubt that this reduction of the grain size is largely responsible for the improvement of the mechanical properties noticed. It seems highly probable that the reduction in grain size is a direct result of the method of casting. There is no evidence that the pressure under which the metal solidifies has any influence on the structure or mechanical properties, and the reduction in grain size is sufficiently accounted for as a result of the motion and agitation of the metal during solidification.

Pinholes and Blowholes.—From a consideration of the method followed in the production of cylindrical castings by the centrifugal process, it will be seen that the manner of solidification of the molten metal is somewhat different from that of similar castings produced by sand-casting methods. Neglecting the end effects in sand castings, the molten metal in cylindrical castings commences to solidify at the inner and outer surfaces to all intents and purposes almost simultaneously. The centre portion of such castings is the last to solidify, hence the necessity for risers and feeder heads to make up the deficiency of metal in the liquid centre due to the shrinkage of the molten metal. In the centrifugal process the mould is rapidly rotating about the horizontal axis, and as the metal is poured in it is rapidly whirled round, completely covering the surface of the mould, and as the molten metal is continually poured in each layer is covered by a successive layer at each revolution of the machine. If the casting has been poured correctly, and all the features of the mould and speed are correct, the solidification of the casting as a whole is practically complete with the last layer poured in, and consequently no feeding is required to make up the effects of shrinkage. If these conditions are not correct, then liquid shrinkage must occur, and this usually manifests itself in the form of markings on the inner surface of the casting, which are really slightly unsound portions resulting from the contraction of the final layers. Shrinkage is often accompanied by slight exudations or pellets resulting from the contraction of the inner portions forcing still liquid metal through to the inner surface. Analyses taken of the exudations show that they are not necessarily highly phosphoric, and this effect is often magnified by the condition of the machines and vibration. For example, any "out of balance" frequently accentuates the appearance of these markings. Neglecting the end effects, therefore, it will be seen that cast under correct conditions the solidification of the molten metal in centrifugal castings takes place from the outside surface to the inside, and the final portion to solidify is the inner surface.

The difference in method of solidification is one of the advantages of centrifugal casting process, and it is to this cause that the uniformity of the fracture can be ascribed, which in its turn is responsible for the high and regular values obtained for the mechanical tests taken on samples cut from the castings. Solidification in this manner is also responsible for the absence of unsoundness and porosity and the elimination of those deep-seated blowholes due to incorrect casting temperature. Blow-holes due to mould gases which are met with in sand castings are obviously absent, as no sand is employed in the process.

The phenomena of the occurrence of small pinholes in centrifugal castings has been referred to by Williams—I.B.F. "Proceedings," 1920. Small subcutaneous blowholes which were probably identical with pinholes were found in centrifugal cast steel castings—American Bureau of Standards Technologic Paper No. 192. There are probably three types of pinholes which have distinct characteristics which enable them to be readily recognised. The first type are not really pinholes, but are minute superficial depressions which very rarely penetrate any considerable depth into the casting. These are due to entrapped air between the mould surface and the rapidly solidifying casting.

The second type of pinholes are probably the most serious, and are strictly pinholes in that they are very narrow holes, literally covering the outer surface of the casting, and extend a considerable depth into the casting. They may, and very frequently do, extend right through the casting, and often lead into a large patch of unsoundness, which is indicated by a characteristic rumpling of the inner surface of the casting. On the extreme outer surface the width of the holes may be large, but immediately they enter the casting they narrow and expand into a pear-shaped hole further in towards the inner surface. Many of the holes are found not connected with the outer surface, but with the opening on this surface completely sealed up. These isolated holes are almost invariably bright and free from oxide scale, but those open on the outer surface may or may not be coated with oxide scale. It is evident from this that this pinhole was formed during the actual solidification period, as indicated by the bending of the primary crystallites, clearly indicated in the photograph. On this and on other ground, it is considered that the pinholes are due to the liberation of the dissolved gases during the solidification of the metal which are trapped in the casting, under the particular conditions of rate of solidification obtaining.

The third type of pinholes cannot be separately distinguished, and the author has considerable doubts as to whether they exist. However, certain occurrences have led one to suppose that an insufficiency of plumbago in the mould is liable to cause pinholes. This is not altogether clear, nor is the reason why this should be so.

A considerable amount of investigation has been carried out on the subject of pinholes, which are the most serious of the metallurgical troubles which have been encountered, and sufficient is now known to be able as a general rule to prevent their occurrence.

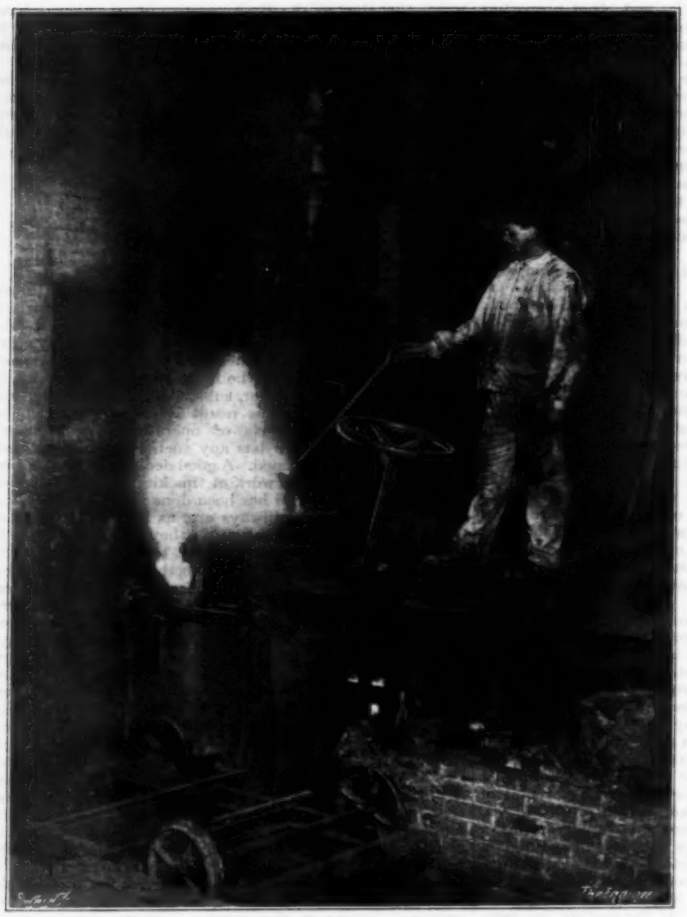
Railway Accidents.

A GOOD deal of praise has been given recently to our railways because of the very satisfactory figures which appear in the accident returns for 1921. We would take our part in tendering these congratulations; the figures are the best published since the present returns were begun in accordance with the Regulation of Railways Act, 1871. We cannot, however, subscribe to the view, universally expressed, that this result is entirely due to the improvement in methods of operation during recent years. In no direction has any such improvement been made since the war opened. A good deal of track circuiting existed then, but little work of this kind has been carried out since, and even less has been done in other directions. The fact is that our railways are, as regards methods of operation, as near perfection as they can be, except in certain matters which have not yet been undertaken, and which, therefore, cannot have affected last year's figures. Not, then, is it because of any improved methods of operation that there was such a gratifying decrease in every class of accident. In some items the decreases were most remarkable. Casualties in train accidents are always fortuitous. There were only three accidents in which passengers were killed, but because fourteen were killed in one calamity, the total was raised to eighteen as compared with two such accidents in 1920, which resulted in five deaths in one and one death in the other. Eleven servants were killed in train accidents, as compared with five in 1920. Three of them met their deaths at Abermule, two at Wapping, and two at Buxton. Passengers injured in train accidents fell from 684 in 1920 to 589 in 1921, and servants from 177 to 81, which, when the increase in the number of deaths is considered, again shows that the results of train accidents are quite fortuitous. It also once more proves the contention we have often advanced that it is the number of accidents and not their results that should be looked at when considering statistics. The remaining principal figures in the returns indicate the following *decreases*:—Passengers killed by trains but not by accidents to trains, *e.g.*, falling between trains and platforms, falling from trains on to platforms, falling from trains in motion, 38.26 per cent.; passengers injured thereby, 24.36 per cent.; servants killed in movement accidents, *i.e.*, by the movement of trains and vehicles but not in train accidents, *e.g.*, in shunting, when working or walking on the line, getting on or off engines, 40.70 per cent.; servants injured thereby, 33.65 per cent.; servants killed in non-movement accidents, *e.g.*, in goods sheds, engine sheds, falling off ladders, 25 per cent.; servants so injured, 24.17 per cent.; collisions involving passenger trains, 37.62 per cent.; collisions between goods trains, 56.15 per cent.; passenger train derailments, 56.32 per cent.; goods train derailments, 39.56 per cent.; breakages of couplings, 29.36 per cent.; failures of couplings otherwise than through breakages, 45.40 per cent.; broken rails, 25.75 per cent.

At first sight it would seem reasonable to suggest that the three months' practical cessation of mineral traffic in the first half of last year and the slump in trade towards the end of the year were responsible for these gratifying decreases. But our inquiries among the railway companies elicit the information that each quarter of the year showed decreases, the first quarter less pronounced than the other three. There also remains the fact that the decrease in traffic, judged by the freight train mileage and freight shunting mileage, was less than the decreases in some classes of accidents. The thirteen principal British companies ran 24.26 per cent. less freight train miles in 1921 than in 1920, and 25.11 per cent. less freight train shunting miles.

Not the least remarkable feature of the accidents of to-day is that their number is about the same as twenty years ago, a fact which strengthens the remark made above that our railways are as near perfection as they can be. During the three years 1899, 1900 and 1901 the average number of accidents to passenger trains was 215 a year. Ten years later—1909, 1910, and 1911—the yearly average was 201. For 1919, 1920, and 1921, the average was 207. These mishaps relate to accidents of every kind to passenger trains, and must necessarily include some in which there were no personal injuries. When we add that the figures are equal to, roughly, one accident a year to every million passenger miles run, one accident to every seven million passenger journeys made, and one accident a year to every 147 miles of track—equal to the distance from Paddington to Cardiff—one really marvels at the security in railway travel the figures reveal. There are, however, as we also said above, certain matters in which there is not perfection. We would like to see yet more track circuiting in order to reduce the number of collisions due to trains and vehicles being overlooked by signalmen; of automatic train control to militate against drivers running by signals at "danger"; of continuous brakes for goods trains; and for something to be done to meet the difficulty of couplings parting—of the last there were 13,000 cases in 1920. None of these things are possible at the present, but when the companies are grouped one improvement they might make in order to reduce accidents and work their freight trains at a higher overall speed would be to equip them with continuous brakes.

CASTING ALUMINIUM BRONZE FOR FRENCH COINAGE



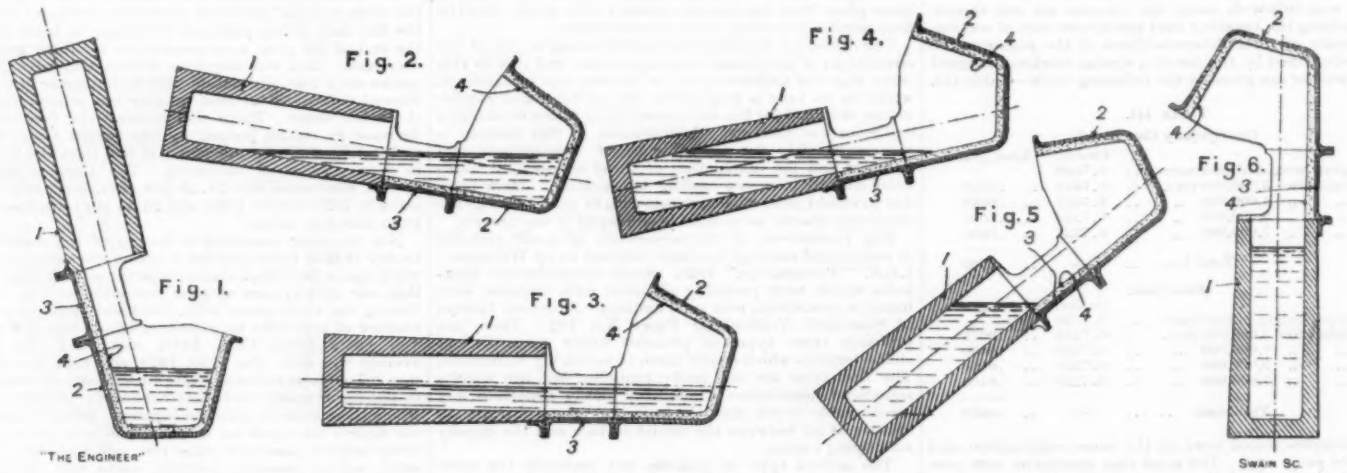
TAPPING THE METAL INTO LADLE

WITHDRAWING PLATES FROM MOULD

New French Aluminium Bronze Money.

THE decision of the French Government to replace the paper money notes at present in circulation with small, golden-like coins of aluminium-bronze, calls attention to this new monetary metal. It is new in the sense that it has only just about to make its public appearance, though chemists and engineers were busy experimenting with it long before the war. Indeed, so far back as half a century Sainte-Claire Deville, recognising the brilliant future before this new alloy of aluminium, justly surnamed it the "French metal." Coinage metal, to be satisfactory, must fulfil certain conditions. It should be smart in appearance, virtually rustless, and difficult enough to manipulate to discourage the counterfeiter. Furthermore, in quality of resistance and value, a light metal is preferable to a heavy one. It should be easy to roll, yet sufficiently hard, must be able to resist attacks of the air, of the damp, of acids, of salts, and in particular must not change colour near the sea. The new aluminium-bronze coins are said to fulfil all these varied and exacting conditions.

So far back as 1909, the French Ministry of Finance set up a Commission, at the head of which was M. Voille, to propose a likely metal to replace the old coins then in existence. M. Henri Le Châtelier, one of the members of this Commission, asked an engineer who specialised in the question of alloys, P. H. Gaston Durville, to prepare him bronzes of aluminium which should approach as near as possible to the metal of Sainte-Claire Deville, in order to try it from the monetary point of view. This skilful technician met with the greatest difficulties in solving the problem, but having founded, in the following year, the Society of Alloys and Forgeable Bronzes, he continued his researches on a larger scale. At length, with the aid of the chemist Hanriot, he succeeded in producing industrially a type of very hard alloy in the form of blank coins ready for the operation of stamping, and in September, 1920, M. Bouvier, Director of the French Mint, resolved to adopt aluminium-bronze to replace the dirty little notes now in circulation.



THE DURVILLE INGOT LADLE AND MOULD

M. Durville is now preparing homogeneous ingots possessing a pretty greenish-gold colour which can be polished as well as the hardest steels. One of the chief difficulties to be faced was the inclusion of scoria, air bubbles and other oxidised bodies when pouring the ingots. To overcome it, M. Durville invented and patented, in 1913, the apparatus herewith illustrated. It is composed of an ingot mould 1 and of a pocket or ladle 2 rigidly connected with each other by a communicating canal 3. These three elements, 1, 2, and 3, are kept in a straight line once they are brought together. The ladle and the canal are lined with a refractory material 4.

At the factory at Mouy-Bury, where the Society of Alloys and Forgeable Bronzes employs the Durville method, the alloy is melted in a crucible, its free surface oxidises and becomes covered with a film of alumina, which protects the parts of the bath below it from further oxidation. Once the alloy is melted the pouring must be effected without the slightest agitation. From the crucible the alloy is poured into the Durville ladle, which is then rapidly attached to the ingot mould. The whole apparatus is then tilted, as shown in Figs. 1 to 6, and the molten mass flows gently from the ladle into the four divisions into which the ingot mould is divided. As will be seen, the surface of the liquid bronze is kept horizontal throughout the operation. The alloy occupies successive positions without the least jerk, until it arrives at the ingot mould, where it solidifies. Its passage from one to the other is accomplished gently and evenly in spite of the rapidity of the flow. As soon as solidification has taken place the ingots are withdrawn, as shown in the right-hand engraving at the top of this page.

The aluminium-bronze leaves the factory at Mouy-Bury in the form of rectangular plates, each one weighing 60 kilos. to 70 kilos., which are then reduced to strips from which the coin blanks are stamped.

THE Swiss Federal Railways have ordered from home factories twenty additional electric express locomotives with a maximum speed of 90 kiloms. an hour, the value of the order being 11,000,000f. During the next four to five years a total of about 100 new electric locomotives are, it is said, to be built.

Road Paved with Pre-cast Concrete Slabs.

LACK of water for mixing concrete on a public road in the State of Wyoming led to the use of the novel method of laying a pavement of pre-cast concrete slabs, which were carried to the site in motor trucks and set in place by means of a portable gantry. This method of construction was devised by Mr. Z. E. Sevison, State Highway Engineer, who considers that it is of advantage, not only where it is difficult to obtain a supply of water, but also where construction or repair has to be carried out without interruption to traffic.

A yard for the manufacture of the slabs was established at Casper. Graded sand and gravel were used for the fine and coarse aggregate, in a concrete mixture proportioned 1 part cement to 2 parts sand and 3 parts clean gravel. The concrete was discharged from the mixer into two-wheeled tubs or bogies, which were pushed by hand to the moulds and there tipped. In the mould the concrete was spread and levelled by spades, and then struck off by a 2in. by 6in. timber, faced with a 2in. steel strip and resting on the sides of the form or mould. The surface was then finished by a roller and by drawing a belt to and fro, while at the same time advancing steadily lengthwise. Finally, the edges were trimmed with an edging tool. These slabs were 8ft. long and 9ft. wide, with a uniform thickness of 6in. They weighed about 3 tons each.

In making the moulds, the ground was carefully levelled, and 2in. by 4in. joists, 14in. apart, were set in it and well packed with earth. Planks, 1in. thick, were then nailed to the joists. This floor was covered with a layer of tarred roofing paper to prevent water and mortar from escaping between the planks, and also to prevent any adhesion of the concrete to the floor. The sides were of planks, 2in. by 6in., spiked to the floor and well braced. Four floors, 116ft. long and 20ft. wide, were built in this way, each floor accommodating a double row of fourteen slabs, with a 6in. space between the rows and a 24in. overlap at each side.

Transverse partitions or headers of 2in. by 6in. plank were set at the proper spacing for the width of slab, being painted with liquid paraffin to prevent adhesion of the concrete. Alternate slabs were poured. After the concrete had set, the headers were removed and the exposed ends of the slabs were painted with the paraffin to serve as headers for the intermediate slabs. Most of the slabs were made with interlocking joints, plaster of Paris headers of proper form being placed across the moulds and painted with paraffin on the faces. Every fourth joint, however, was made with flat vertical faces. The slabs were numbered consecutively, and were laid in the road in the order of their numbering.

Steel reinforcement in each slab was designed to prevent cracks or fractures in handling. Near the bottom of the mould was stretched a layer of heavy wire netting, together with transverse bars, ¼in. in diameter, at 14in., 24in. and 30in. from each end. These bars were 2in. from the bottom of the slab. At 2in. from the bottom and 20in. from each end were set four pieces of galvanised iron 2in. pipe. A longitudinal ¼in. bar, 3in. from each side, was laid over the pipes. With this steel work secured in place, the concrete was poured into the form. Different arrangements of reinforcing steel were used for experimental purposes.

When the concrete had taken its initial set, the slabs were covered with 2in. of sand, which was kept damp for fourteen days. After being left for three days longer, the slabs were lifted by jacks engaging hooks set in the pipes embedded in each side, and rollers were then placed under them so that they could be moved off the floor and stacked. They were then left for thirty days before being sent out to the road. The method of manufacture produced a smooth, even, and extremely hard surface.

For transporting the slabs, chain slings had their hooks attached to the pipes set in the slabs, and were then hooked to a 3-ton differential chain hoist on a small portable gantry, and were thus loaded on motor trucks. The formation level had been prepared and levelled in advance, and covered with a 2in. sand cushion. The slabs were laid to form one side of a 32ft. roadway, with a drainage slope of 1in. to the outer edge. The motor truck ran alongside the site for the slab, where another portable gantry was stationed, having a trolley which carried a 3-ton chain hoist. This picked up the slab by chain slings, traversed it into position, and then lowered it upon its bed.

After a year of heavy traffic, Mr. Sevison reported that the wearing surface was in excellent condition, and that the slabs showed no signs of displacement.

ELECTRIC light is now being supplied in Howick, Natal, from the local water-fall, which has been harnessed by a rubber factory, more power being produced than the factory itself requires.

THE Austrian National Assembly has ratified the Cabinet's decision granting Marconi's Wireless Telegraph Company, of London, a concession to erect and work wireless stations between Austria and other countries. The concession must be transferred within six months to an Austrian company to be formed for this purpose under the control of the London Marconi Company, which will subscribe more than 50 per cent. of the capital. The Austrian Government will participate to the extent of 30 per cent. of the capital, and a group of Austrian banks will co-operate with the Marconi Company in founding the Austrian company. The rates for messages will be the same as those charged for telegrams by wire. The concession is granted for a minimum period of thirty years with the possibility of renewal. The Marconi Company will take over the Austrian Government's existing wireless stations at Deutschaltenburg and Laaerberg and, after transforming them into modern stations capable of transmitting or receiving 150 words per minute, will hand them over to the future Austrian company. The grant of this concession was, it is said, in spite of very strong foreign competition, especially on the part of the Berlin Telefunken Company.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Reduction in Rail Rates.

THE new railway rates are being subjected to a good deal of criticism in iron and steel circles in the Midlands, ironmasters in particular being extremely dissatisfied. The "cuts" will have very little direct effect on the iron trade, which will benefit only indirectly from the concessions through the assistance given to hardware industries using iron and steel as their raw materials, and ironmasters argue that no small alleviation of the burdens on general merchandise will promote such a revival as to revitalise the basic industries. There will be some slight advantage accruing from the new rates for ore and fuel, but it is considered to be negligible. It was expected that in the readjustment of rates special consideration would be given to the parlous state of the iron trade, on which the earnings of the railways so largely depend. It is expected that the immediate effect of the reductions will merely be to postpone the placing of new business, traders, in view of the fact that the reductions come into operation on August 1st, being disposed to postpone shipments in order to take advantage of the lower rates.

The Manufactured Iron Trade.

There is a decided change for the better in the local manufactured iron trade, and several local ironworks have been able to re-start after considerable periods of idleness with a fair number of orders on their books. There has been during the past week or so a very welcome accession of orders for Staffordshire mills, though it must be admitted, business has not been so widely diffused as it might have been. Bars for the nut and bolt trade are being more freely bought, and the price remains firm at £10. The improvement in the demand for fencing bars is also maintained, and prices rule at £10 2s. 6d. per ton. Belgian mills are making strenuous endeavours to get a larger share of this trade. Some very low quotations are reported this week. Bars suitable for either nut and bolt or fencing purposes are being offered at £8 12s. 6d., delivered in the Black Country. This is £1 7s. 6d. below home makers' prices, but continental exporters are handicapped by the long time required for delivery, and do not appear to be making much impression on the market. Though the question of the price of Staffordshire marked bars has again been under consideration, the Bar Makers' Association has decided to maintain the present figure of £13 10s. as the standard for marked bars. Owing to the fall in values of unmarked iron, the traditional difference between best and ordinary material has been exceeded. But ironmasters are hopeful, and definitely express the view that price changes are likely to be in the upward direction. Some of the Staffordshire ironmasters who devote themselves to the re-rolling of steel are rather busier. They have the advantage of cheaper Belgian billets which have come on to the market during the past week as the result of the fall in the value of the franc.

Fall in Galvanised and Tinned Sheet Prices.

Galvanised sheets are reduced 10s. per ton, the price having fallen from £16, at which it has stood for some months, to £15 10s. and £15 12s. 6d. Black sheets are also down 10s. per ton, bringing them to £12. As I pointed out last week, the year opened with galvanised sheets at £16 10s., so that during the half-year prices have suffered a fall of 20s. Tinned sheets have been reduced by £2 per ton. At a recent meeting of the Tinned Sheet Manufacturers' Association, at which the trade position was reviewed, it was decided to declare prices for the present quarter as follows:—Best charcoal, 56s.; charcoal, 54s.; unassorted, 50s. per cwt. to 20 gauge in each case. The basis price for lead-coated sheets was fixed at 28s. per cwt. to 20 gauge.

Pig Iron.

The pig iron market is considered to be a little stronger this week, but prices are maintained by the high cost of production rather than by any pressure of demand. While values generally have not been influenced by the increased prices recently quoted in individual cases, and it is considered improbable that these have been ratified by actual business, it is widely felt that an upward movement in prices is more likely than the reverse. Judged by their purchases of raw material, the foundries are showing a little more activity, and smelters are pleased to receive orders, if only for small lots, for forge material. It has been some months since there was any demand at all for this iron, and makers are eager to get rid of the stocks they have been accumulating. There is not so much export business as there has been of late, but this business has helped to tide smelters over a dull period in the home trade. An outlet has recently been found for some of their production in Scotland. In North Staffordshire an additional furnace has been blown in. For Northamptonshire forge iron about 70s. is required, and for No. 3 foundry the quotation is 80s. Derbyshire makes command about half-a-crown more in each case.

Birmingham Billet Supplies.

Conditions in the steel market improve but slowly. Since the basis for steel plates and sections was lowered, competition for orders has been intensified, and such business as is being negotiated is of little use to any body. It is of so little use that some Midland houses which took the strong line of refusing compliance with the new bases still decline to come into line. A significant development is the abandonment of the concerted effort to exact special terms for South Wales billets in the Birmingham zone. In effect, a cordon was drawn round Birmingham and the Black Country. On crossing this line, which described a circle 20 miles from Birmingham, South Wales billets were to jump in price from £7 7s. 6d. to £7 15s. Since this discrimination against the district was resolved upon in March, its authors have seen the trade go elsewhere. Birmingham has found no difficulty in satisfying consumptive requirements at lower prices than those which the combine sought to enforce. The lesson has been taken to heart. Some of the firms in the confederacy have been greatly chagrined at the way in which the tables have been turned on them, and they have now taken a free hand to quote any price down to £7 5s. for the Birmingham district. The abandonment of the attempt to dictate an artificial price for billets has been followed by stiff competition for the few orders offering, one Welsh firm seeking orders at £7 5s. Belgian steel is not now competitive in this district, although in South Wales, where railway charges are trifling, sheet and tin bars can be bought somewhat favourably in competition with local steel.

Coventry Matters.

Coventry's industries, motor and cycle, are steadily recovering, and at the moment most of the firms are busy and showing an increased output, but there is room for much improvement, as is shown by the local unemployment returns. While certain firms have absorbed more labour, others have dispensed with an almost equivalent percentage. In connection with wireless broadcasting, it is interesting to hear that one of the great electrical firms of the country is about to make receiving sets on a large scale at its recently erected Coventry works. Another local firm engaged in the production of internal combustion engines has started additional hands.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

General Outlook.

REPORTS as to the condition of the markets, both for iron and steel and for the non-ferrous metals, vary in the strangest way, and it seems safest now to believe none of them. Even so definite a matter as the character of the last quarterly meeting of the iron trade, which was held last week in Birmingham, is reported in opposite terms, one man telling the writer that it was very cheerful and another that it was the worst and most depressed quarterly meeting that he had attended. The truth is that when a firm secures an order, it reports things as improving, and when it fails to do so, then things are very bad. There is really very little, if any, indication yet of steady improvement in the iron and metal trades, and the general condition of the world of commerce is against any rapid movement towards better times. For one thing, the general wealth of the world takes time to grow after the orgy of destruction through which we have recently passed.

Metals.

There is a very strong feeling just now in the American copper markets that prices are going to rise, and, in fact, the domestic price for electrolytic copper has been advanced there. It is rather difficult for us on this side to arrive at the reasons for this optimistic feeling, and probably it is sustained by local influences rather than by any expectation that the world consumption of copper is likely to increase very rapidly. Apparently, the supply of refined copper in America, apart from that reserved for the export trade, is small in proportion to the demand, and there has been talk of shipping rough copper from Europe to America for refining purposes; but this seems rather an extravagant course to take. The actual consumption of copper in this country is said to be a little better; but one does not see many signs of activity in the Manchester market. The engineers in this district are not buying very freely, but this is not because they are afraid of the prices, but because they have not much work in hand. It is perhaps reassuring, so far as the stability of prices is concerned, that the quotation for best select ingot copper has remained unaltered for a month. There has been no improvement in the continental demand for copper during the week, but this may be attributed to the uncertainty of the position in continental exchanges. There is certainly considerable apprehension in regard to the French exchange. The recent fall in the value of the franc dispelled the idea that we were gradually getting back to stability so far as France and Belgium were concerned. The market for tin keeps steady, and there is very little change in the general situation. Merchants here seem still rather sceptical about the soundness of the market, but it is a fact that there has been practically no fall in tin prices for six weeks. American buying is rather feeble at the moment, but that market has had some big deliveries of late, and it is probable that consumers there are well supplied, at any rate for a month or two. In the market for lead we have still much the same conditions. The long-expected collapse in lead prices is still delayed, and people are not now so confident about it as they were. The demand from the cable manufacturers is heavy, and it is said that there is now a better demand for manufactured lead for other purposes. Spelter is quite a firm market, and looks like being better. The rise has been slow and steady since February, but it amounts to £4 per ton, or roughly about 16 per cent.

Pig Iron.

The market here for pig iron remains quiet, and there is not much local change; but there is some doubt as to what is going to happen in Cleveland iron. Makers of this iron have been in voluntary fetters for so long that they do not quite know what to do with their unaccustomed freedom. There have been sales of No. 3 at 89s., although one cannot say that this is a regular price; and in any case a very much bigger reduction than 1s. will be needed to bring any quantity of Cleveland iron into Lancashire. Founders here are buying in moderate quantities No. 3

Derbyshire iron at about 91s. per ton delivered in Manchester, and so far as one can ascertain the quantities bought are fully equal to those being produced by the furnaces now in operation. It may be that the stocks at the furnaces are being encroached upon, and this is stated as a fact by some makers. Of course, it will have to go on some time before all the reserve is exhausted and it becomes necessary to light up more furnaces. Those who are interested in pig iron prices naturally do not believe that any serious rise is possible until this has been done. The new railway rates, when they come into operation, will reduce slightly the cost of making pig iron, but it is said that this reduction will not be a very serious affair. The Glasgow Fair holidays prevent us from getting any clear idea about the Scotch prices or the position of the pig iron trade there; but here there is a fair demand for Scotch pig iron at the old prices. Hematite iron is still very weak, and sales of East Coast hematite have been made at 91s. f.o.b. for export, although the home buyer is expected to pay 94s. There is talk of blowing out some of the furnaces or perhaps putting them on another class of iron. The state of this market is, of course, a sign of lack of business in the steel trade.

Finished Material.

The demand here for finished iron and steel is still poor, and reports of improving trade are received with some scepticism. There would seem to be a good many small orders about, but, of course, the prices obtainable are very unsatisfactory. Those works which are best equipped may possibly scrape a little profit out of them; but in other cases they are probably taken at a loss, that is, so far as the steel orders are concerned. There must of course, be a good profit on any iron orders that can be obtained at the official prices, as iron-making materials are cheaper in proportion than steel-making materials, and the selling prices for finished iron are higher.

Scrap.

In the market for scrap one does not see any definite change. There is no doubt that dealers are anxious to get more orders for foundry scrap, and possibly there is some competition in the prices; but as a rule £4 per ton is asked for good broken machinery iron of ordinary quality. Wrought scrap is not being offered very freely, and dealers are of opinion that the ironworks will soon be compelled to offer more than 70s. per ton delivered for it, if they desire to get an adequate supply.

South-East Lancashire Electricity Board.

At a meeting held in Manchester of the South-East Lancashire Advisory Board recently, Alderman W. T. Dagnall, chairman of the Manchester Corporation Electricity Committee, was elected chairman, and Dr. Parshall, who is a director of the Lancashire Electric Power Company, was appointed vice-chairman. A committee of technical engineers was also appointed. The Board is an interim authority to act until the parliamentary order is issued constituting the new body, and has been formed on the advice of the Electricity Commissioners.

Miners' Wages.

A conference of the Miners' Federation is being held this week at Blackpool to consider what action, if any, is to be taken to amend the wages agreement. Under this agreement the income of each area into which the mining districts of the country were divided, after the payment of all colliery costs, is divided in the proportion of £83 in wages to £17 in profits. There is a fixed minimum wage for each area. If the income is insufficient to provide the agreed percentage of profit to the colliery owner when wages are paid at the minimum, the owner has to sacrifice his profit; and when the income fails to provide the actual wages paid to the men the deficit remains a charge upon the future income.

BARROW-IN-FURNESS, Thursday.

Hematites.

The improvement in trade which was expected after the settlement of the shipbuilding and engineering troubles has not materialised. It would appear that the makers who relied upon better business let iron go into stock during the lock-out in the confident hope that the subsequent demand would soon clear it up. It has not come to pass, and in consequence another furnace, which has been engaged upon the making of low phosphorus iron at Cleator Moor, has been damped down. The Cleator Moor works are the property of the North Lonsdale Iron Company, of Ulverston, which damped down one of its furnaces at Ulverston last week. Everything points to the fact that the present trade is still confined to mixed Bessemer numbers, and that the business in better qualities of iron has yet to develop. Inquiries elicit the fact that many engineers who in ordinary times are customers for special qualities of iron are but indifferently engaged at present. Neither Scotland nor the Midlands are big buyers at the moment. There is a fair trade with the Continent, comparatively speaking, the last cargo of iron going to Treport. When shipbuilding and engineering revive, the hematite iron trade will liven up also.

Iron Ore.

The iron ore trade is dull and the stoppage of two furnaces in the district will affect the local mines and result in more unemployment. The Roanhead Mines are quieter, but it is interesting to report that the Hodbarrow mines at Millom are starting again, but the amount of ore brought up will be restricted. It may be that the ore trade from Millom will improve, and this will lead to a sea-borne trade again. Foreign ore is in limited demand, and one cargo of Spanish arrived last week.

Steel.

There is not much life in the steel trade. The Workington mills have stopped again, but at Barrow the rail, merchant and hoop mills are engaged. The foundry is also partially employed. There is no trade in ship plates or boiler plates, and the same remark applies to billets. There has been a further shipment of rails to Ireland (Kingstown).

Shipbuilding and Engineering.

The internal combustion engined tanker Scottish Musician, The last of four similar vessels, built for Tankers, Limited, by Vickers Limited, has been completed this week and left the port for her trials in the Irish Sea. Her performance was very satisfactory. At full power she maintained a speed of 10¾ knots as compared with a guaranteed speed of 10½ knots. The Australian Commonwealth liner Jervis Bay will be ready for departure next week. She will proceed to Liverpool to dry dock, and from that port will proceed to London to take up her station. There are no new orders reported yet, but it is thought there will be an improvement in the outlook shortly.

SHEFFIELD.

(From our own Correspondent.)

Slow Progress.

RECOVERY in the local steel and engineering trades is still a painfully slow process; what business there is seems to be very unevenly distributed, for some firms are working full time while others have the greatest difficulty in providing about half-time employment. Perhaps the worst department is that concerned with crucible and special steels for making engineers' tools, for which there is still a very small demand, and this demand can be more than met from the accumulated stocks still in hand. There is, however, a slightly better report from the finished branches, a number of makers of saws, edge tools, &c., being quite busy. Agricultural and gardening tool makers have also had, on the whole, a fairly good season—much better than its belated opening seemed to promise. Mining developments are also bringing a larger volume of work to those Sheffield firms which specialise in this branch. The heavy steel trade maintains the improvement to which reference was made in this column last week. More furnaces are being started up each week, and, generally speaking, it is probably not far from the truth to say that steel-making plants in this district are now working at something like half capacity. This is, of course, an average—in some cases the figure is considerably higher, and in others it is too generous an estimate. But the position varies almost from day to day, as orders are being placed with much more freedom, though still, for the most part, in limited bulk. There is some hope that now that the railways have lowered their freights they will before long find it necessary to increase their rolling stock and put in hand the repairs which must be long overdue. But no orders of any magnitude have yet been placed. The slow rate of progress made in the local trade revival may be judged from the fact that the number on the unemployment register has not yet been reduced by 10,000 since the settlement of the engineers' dispute, during which it stood at 50,000; it remains still at well over 40,000.

Looking Overseas.

With the stringency of money for public works and development schemes at home, and the unsettled conditions on the Continent, local manufacturers are looking more and more to the overseas markets, and recently it is satisfactory to note a good deal more inquiry has come to Sheffield from these quarters. In some cases prospective customers frankly confess that they have hitherto been buying from Germany, being compelled to this not very palatable course simply by force of economic circumstances and the pressure of competition. Now, however, they are finding not only that German prices are above British quotations, but that delivery is no longer anything like assured. In a specific case brought to my notice this week, steel of a certain specification had been supplied by a German maker at £14 per ton when the Sheffield price was in the neighbourhood of £22; the latter is now a few pounds lower, while the German manufacturer is asking the exchange equivalent of £38. There appears to be a general recognition in this district that Germany can no longer buy raw materials at the price at which finished steel products can be made at a competitive figure, and that country is no longer regarded as a serious rival in this trade. There is, however, a far more real danger in the increasing activity of the American manufacturers, and both in Canada and in South America the competition promises to be very keen. One country of great potentialities to which Sheffield firms have not, generally speaking, hitherto devoted much attention is Chile, and in the course of a visit paid to this district during the present week, Mr. Vaughan Scott, H.M. Commercial Secretary at Santiago, has done a great deal to enlighten Sheffield manufacturers concerning the great opportunities afforded by the prospective development of that country's industrial resources. There are considerable mining developments in progress, at least two railway electrification schemes are contemplated, and port and harbour works may be put in hand in the comparatively early future. There is a disposition on the part of the Chilean Government and commercial interests to develop local industrial resources, and for this purpose a good deal of semi-manufactured steel and other materials will be required, and Mr. Scott has been able to show Sheffield manufacturers that the country he represents is well worth attention. It is probable that a loan will be raised for these requirements, and in this case it will no doubt be agreed to give the country providing the capital the benefit of a preferential tariff in regard to the imports needed in connection with this scheme of industrial expansion.

Sheffield's Small Share.

The Board of Trade figures for June do not furnish a very safe index to Sheffield trade, because while the returns show a very great recovery in the iron and steel trade as a whole, not much of it has come to this district. The increased exports are mainly in pig iron, tin-plates, galvanised sheets, rails and steel strip, while there was a decided drop in most engineering products. The month was one of the poorest ever experienced in railway axles, tires and springs. It is true that the Lincolnshire iron and steel works, the majority of which have been standing idle for something like a couple of years, are now working at about two-thirds capacity, but a large proportion of their output is destined for the South Wales tin-plate trade, and Sheffield is taking a comparatively insignificant share. Another order has just been secured by Ruston and Hornsby. This is from the Douglas (Isle of Man) Corporation in connection with the electric lighting scheme which is being undertaken at a cost of about £100,000. The order for the main station plant has been placed with the Lincoln firm. The engines to be supplied are two Ruston twin-cylinder cold-starting oil engines, each of 340 brake horse-power, arranged to drive continuous-current dynamos.

The Light Trades.

Sheffield's "light" trades are in a very parlous state. As has been stated above, there is still very little demand for small tools, and the cutlery shops are, generally speaking, greatly overstocked with products made when costs were much higher than at present, with the result that they cannot be retailed at prevailing prices. The employers wanted to introduce a new price list based on three grades of work, the cheapest being with a view to meeting the foreign competition in goods of a quality that Sheffield makers have hitherto been disinclined to touch. In the aggregate the new lists mean a reduction of something like 33⅓ per cent., but the men have refused to accept them, with the result that this week about one thousand cutlery workers have been locked out. The employers are, however, by no means united in this attitude, and two of the largest firms have made separate arrangements with their workers, and others are likely to follow this lead. Cutlery and electro-plate contracts for the Admiralty and for big hotel and catering companies have lately been placed at very keenly competitive prices, and the margin of profit has been reduced to almost vanishing point.

The Fuel Position.

Industrial fuels are still, in the opinion of steel makers, much too high to permit of this latter industry making much headway. At the Coal Exchange luncheon and annual meeting the other day, Mr. W. B. Pickering, a director of Hadfields, Limited, said the steel trade had now got wages back to a figure that gave firms a better chance of meeting foreign competition; the railway companies had followed with a certain concession—not so much as it ought to be, but still helpful—and now they looked to the colliery companies to do their bit, as he thought they might in view of the fact that their production costs were now approximating to pre-war figures. Mr. J. W. Hazel, the secretary of Tinsley Park Colliery Company, Limited, promptly corrected Mr. Pickering's figures, showing that colliery wages per ton of coal now stood at 12s. 6d. as against 6s. pre-war, and the total costs at 18s. 4d. as compared with 8s. The lighting of additional blast-furnaces has, of course, increased the demand for fuels, and the railway companies are, it is reported, also taking somewhat larger deliveries of coal; there is still a shortage of slacks consequent on short-time working at many of the pits in this district. Prices, generally speaking, are not easier.

NORTH OF ENGLAND.

(From our own Correspondent.)

Reduced Rail Rates.

ONLY a nibble, and not of sufficient value appreciably to affect trade, aptly sums up the position of representative business men in the iron and steel trades of the North of England regarding the reductions in the railway rates. To say the least, the majority of traders are disappointed with the reduced rates, and the view is generally shared that the concessions will not assist very much in the restoration of business, so far as the staple industries of the North are concerned. The proposals of the railway companies are a step in the right direction, but admittedly the "cuts" are not generous enough to warrant manufacturers to adopt a brighter view of the future. Trade is recovering, it is true, but with burdens of several kinds pressing heavily, there seems little prospect of a speedy return to normal working conditions. The meagreness of the reduced rail freights is strongly commented upon in local trading circles, and manufacturers will have to look to other avenues if they are to return to prosperous times. The relief afforded to traders in these parts amounts in all to only 2s. 1d. per ton on finished steel, a concession that is not regarded as satisfactory. The reduction on coal is only 15 per cent. of the additional charge above base rates, while the flat rate is reduced from 3d. to 2d. The actual increase in coal rates, which are mostly short journey hauls, and of which the flat rate therefore forms a considerable percentage, is 67.12 per cent., as compared with 1914. It is contended that the flat rate additions, which bear most heavily on short-distance traffic, should be abolished. The reduction on iron ore and limestone is only 1d. per ton, and the only concession in the rate of finished steel is 2d. per ton off the flat rate. The last-named is a disturbing element to the shipbuilding, bridge building and engineering trades, as carriage has to be paid on steel to their works, and again on the finished structures for home and export. The flat rate of 4d. per ton on short distance traffic represents on much of the traffic to local users of steel an addition of 25 per cent., making the actual rate still 100 per cent. above pre-war figures. The position of steel joists and angles for export as affected by rail, wharfage, dock and shipping charges, is illuminating. Compared with the total of 2s. 0½d. in August, 1914, they will be next month 4s. 10d. Matters are further aggravated by the fact that

in some other districts similar steel can be put f.o.b. for export at 2s. 6d. per ton less than the charges for shipment at Middlesbrough docks. The actual railway rates per ton on finished steel, comparing August, 1914, with August, 1922, after allowing for the further reductions, are as follows :—

	August, 1914.	August, 1922.
	s. d.	s. d.
Coal	5 4·6 ...	8 11·93
Iron ore, limestone	5 3 ...	8 3·11
Lime, basic, bricks, &c.	0 11·77 ..	1 9·33
General stores	1 0·83 ...	2 4·75
Delivery charges on finished steel	6 11·71 ...	12 6·49
Totals ...	19 8·34 ...	33 11·44

Shipbuilding Future.

The outlook for shipbuilding in the North is very obscure, but those well qualified to speak assert that the slump has not yet reached its bedrock level. Another two years are given as an estimate before the industry re-establishes itself, and there is good ground for believing that the forecast will not be far wrong. There is no sign whatever of ships being ordered, and the general trend of events seems to suggest that shipbuilding will almost be non-existent for some months to come. If this should be the case, it is natural that the recovery of the iron and steel trades will be considerably retarded, for one cannot do without the other. It is not a very encouraging prospect. The salvation of the shipyards in the future seems to lie in repair work, and in this direction an improvement is noticeable, but not of sufficient importance to warrant the re-employment of large numbers of workers.

Cleveland Iron Trade.

The Cleveland iron trade presents some uncertain features, and since the "freeing" from control of pig iron prices there has been a tendency on the part of buyers to await events. This has reacted on the amount of business passing, though, of course, the holiday season may have something to do with the prevailing quietness. Another factor, and undoubtedly the most important, is that buyers are waiting for the "cuts" which they confidently expect. It is reported that business in No. 3 Cleveland G.M.B. has been done at 88s. per ton, but most producers hold out for the old price of 90s. Producers are certainly showing a disposition to reduce prices in order to sell their iron. Stocks are accumulating fast, and unless the demand improves it is hinted that furnaces may have to go out of operation. In fact, one has already ceased working, but this is primarily due to its unsatisfactory production. No. 1 Cleveland iron is scarce, and the price is firm at 95s.; No. 4 foundry is nominally 87s. 6d.; No. 4 forge, 85s.; and mottled and white, 80s. per ton.

Hematite Pig Iron.

There is a good supply of East Coast hematite pig iron and mixed numbers are freely offered at 91s. per ton for export, with the premium for No. 1 ranging from 6s. to 1s. per ton. Makers ask a slightly higher price for home purposes, but buyers are not inclined to pay 94s., the nominal home quotation.

Iron-making Materials.

Business in foreign ore is lifeless, and no trade is being done. Best Rubio ore is nominally 25s. per ton c.i.f. The coke market shows a tendency towards reduced prices, and Durham blast-furnace coke is offered at 26s. 9d. per ton delivered at the works. It is stated that the price should be easier next month, as the new railway freights are said to equal a saving of about 5s. per ton in the cost of transport from the Durham collieries to the furnaces.

Manufactured Iron and Steel.

The manufactured iron and steel trade appears to have a brighter appearance, but very little new business is reported. There is some hesitation on the part of home consumers to launch out, because they anticipate easier prices. Quotations are maintained in the home market, and no alterations have been recorded this week.

The Coal Trade.

The Northern coal trade is gradually coming into its own again, and possesses brighter features than it has done for some months past. There is also a spirit of optimism prevalent, and business is so varied in character that a feeling prevails that the district is on the highway to complete recovery so far as trading matters are concerned. New business is being attracted. An important piece of news this week is that the United States are making inquiries for 20,000 tons of screened steams for early shipment to New York, while three or four large parcels of gas coals are being shipped. Constantinople and other Black Sea and adjacent ports are throwing out feelers, but business here is being somewhat hampered by the question of values. The tone of the market throughout is one of confidence, and there are signs of better times ahead. Both Northumberland and Durham are sharing in the improvement, as is evidenced by the number and value of inquiries from the Continent and elsewhere. The Amsterdam Gasworks are in the market for 60,000 tons of gas coals for shipment from August to November; also the Bergen Gasworks for 18,000 to 20,000 tons for shipment from August to October. Business has also been done with the Stockholm Gasworks for a supply of about 40,000 tons of ordinary Durham gas coals over a varied period, the price, it is understood, being 26s. per ton c.i.f. The coke market is improving, and is steadier for any class of foundry coke, and there is a brisker demand for gas coke. The Northumberland steam coal section maintains its strength and activity. All the collieries are well stemmed for best screened steams, and producers are not inclined to commit themselves any further. Consequently, prices are very firm. Pace can just be kept with the demand for second-grade steams, both screened and small. Altogether the position is most satisfactory.

SCOTLAND.

(From our own Correspondent.)

The "Fair" Holidays.

THROUGHOUT the past week the various markets were almost entirely dominated by the holiday feeling. The general stoppage took place on Thursday, but some works were closed a day or two earlier. Few establishments will be reopened before the beginning of August.

The Outlook.

Manufacturers hope to see better things when activities are resumed, but it cannot be said that indications promise an expansion in business meantime. General conditions continued quiet right up to the commencement of the holidays, and so far as trade improvement is concerned, it is still a question of "wait and see." Great hopes are centred in the shipbuilding industry, but there is little sign of expansion in that direction so far. The question of prices is still a stumbling block. Manufacturers contend that their charges are the lowest possible, and, in fact, in some cases unremunerative, but buyers are evidently confident that lower rates cannot be long delayed. The promise of further reductions in railway charges, if borne out, may help matters. Meanwhile, however, there are few signs of trade expansion.

Steel and Iron.

Since the settlement of the trouble in the engineering trade steel makers have been looking for an increase in business, but have had little cause for satisfaction. Orders have been few and far between, and certain products have been almost entirely without movement. Steel plates have been exceedingly short of orders, and sectional material, though a shade busier, has reaped little benefit. Black and galvanised sheets have done a moderate export turnover and still have fair inquiries, but the home trade is extremely dull. The demand for heavy scrap has been a bright spot, and though quiet in the meantime, the turnover is expected to expand after the holidays. The bar iron industry just moves along. The shipping demand provides a few orders, but little or nothing fresh is being done on home account. Continental competition is keen. Good sales of continental billets, slabs, &c., have been reported at prices considerably below local charges. The demand for hematite pig iron has been far below expectations. Foundry qualities, on the other hand, have done comparatively well. Some time ago the Glasgow pig iron ring commenced to hold a weekly meeting, and almost since the beginning buyers have been conspicuous by their absence. At last week's meeting sellers were quoted No. 3 Scotch G.M.B. at 98s. f.a.s. Glasgow; No. 3 Cleveland G.M.B. at 89s. f.o.b. Middlesbrough; and mixed numbers East Coast hematite at 94s. f.o.b. Middlesbrough.

Coal.

Conditions in the Scotch coal trade remained unaltered right up to the closure for the holidays. The home market was almost devoid of business, only an occasional lot changing hands at prices favourable to buyers. Round coals show a further drop in values. Washed nuts were busy throughout, chiefly for shipment. Many steamers were in port awaiting loading turns, and a number had to remain over the holidays. Prices of washed materials are firmer. The aggregate shipments amounted to 301,413 tons against 280,016 tons in the preceding week, and 293,892 tons in the same week in 1913. The majority of the collieries will reopen on Monday, the 24th.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

SINCE writing a week ago the steam coal market has taken a slight turn for the better. This is not so much manifest in actual prices, although these are a shade improved, as in the fact that the downward trend in values has been arrested. The position is that collieries' stem lists have filled up, and now that they have more business on their books they can afford to decline to cut their prices in order to secure the release of wagons and enable their pits to keep working. This unfortunately is not general in its application, as quite a number of collieries are still in difficulties, and as an instance it may be mentioned that the Glamorgan collieries have had to give fourteen days' notice to about 3800 workmen to terminate their engagements owing to the impossibility of working the pits on the basis of the recent prices without incurring heavy losses. Still, it is hoped that before the expiration of the notices the situation will have improved to such an extent as to justify allowing the men to continue at work. There is no doubt that the near approach of the August holidays is responsible for exporters hooking their requirements a little earlier to ensure securing their shipment in good time, and also the fear that reduced outputs may result in supplies not being so freely obtainable as they have been recently. Up to now there has been no expansion in the demand from Italy and France, which in normal times are the best markets for South Wales steam coal, but the foreign exchanges have been responsible for a fair amount of business being held up, in addition to which pretty good stocks are held. These must first of all be liquidated before healthier conditions prevail, but it is just possible that the inquiry may be stimulated by the fact that inquiries have been received on this market for supplies of coal for America. A certain amount of business has been done, but there is still further considerable inquiry for cargoes, and whether this results in actual operations or not it is calculated that it will have a sentimental effect upon other possible buyers abroad, and induce them to come on in case prices advance to an appreciable extent. So far the demand from America has been principally for gas coals, and the orders have as a consequence gone to the North, but the uncertainty as to what amount of business may come to this district and what the duration of the American strike of miners may be has added interest to the conditions prevailing. In some quarters the better tone ruling on the market is regarded as only temporary, but in any case it looks as if the conditions for the next three weeks or so will be better, and at any rate it is satisfactory that the falling tendency in prices has been checked.

Railway Rates.

The interesting announcement was made during the latter part of last week that in respect of coal, coke and patent fuel there was to be a percentage decrease in railway rates from 75 to 60 per cent. and the flat rate is to be reduced from 3d. to 2d. per ton, these concessions to operate as from August 1st next. This news had anything but a satisfactory reception, as traders are very much disappointed that the Great Western Company has not granted them more liberal reductions. Furthermore, the Great Western Company says nothing about any reductions in dock charges, and shipowners contend that their claims in this respect are more pressing than those of the coalowners. It is possible that dock charges will be dealt with separately by the Great Western Company, and that an announcement on this matter will be made later. The question of the railway rates will be considered by the Commercial Committee of the Coalowners' Associaton and the General Committee of the Traders' representatives, and with them will rest the decision regarding the prosecution of the demand for lower transport and shipment charges. The application of the South Wales coalowners was for the total abolition of the present flat rate of 3d. per ton and the reduction in the percentage increase of pre-war rates from 75 to 50. The effect of these concessions, if they had been granted, would have been the imposition of charges half as much again as those in operation in 1914. South Wales contended that this district should be treated separately from the other districts, and the refusal of the Great Western Company to abolish the flat rate denies this claim. The necessity for dock charges being dealt with, is shown by the fact that prior to the war railway rates and shipping charges at the Welsh ports averaged from 1s. 10d. to 2s. per ton, whereas, even allowing for the reductions now announced, these rates and charges will still average about 3s. 7d. per ton, or nearly 100 per cent. above the pre-war level.

Cardiff-Dowlais Steelworks.

Although the state of trade scarcely justifies the action, Guest, Keen and Nettlefold re-started on Monday last No. 1 furnace at their works at Cardiff. This step has been taken in order to alleviate the unemployment prevailing, and if later the prospects appear better than they are now, it is possible that the company will re-start other furnaces. No. 1 furnace had been sealed for sixteen months, and when opened it was red-hot. The initial charge to re-start the furnace included three railway truck loads of timber, on top of which was placed coke, ore and limestone. The operations were conducted by Mr. T. P. Martin, the blast-furnace manager. Three-hour shifts will be worked, and it is expected that employment will be given to about 250 men.

Current Business.

The general inquiry on the market shows no material expansion, and business is still very difficult to carry through, as many buyers abroad are still looking for reductions in values, but in this respect they are likely to be disappointed, so far as obtaining their supplies during the next three weeks or so are concerned, as the market displays a better tendency, and when foreign consumers see that there is rather more business activity for America, it is just possible that they may consider it advisable to come in. The American demand, it is true, is rather an unknown quantity, and it is impossible to say how long the strike of the miners in the States will last. Should the present inquiries result in business, it is quite expected that they will give a fillip to the market, which it badly needs. Previously, the inquiries have not yielded much actual business, so that one is naturally cautious as to looking for important results from those now circulating.

Latest News from the Provinces.

WALES AND ADJOINING COUNTIES.

Steam Coals.

THE steam coal market shows a decidedly improving tendency, and coalowners are firmly quoting top prices, with result that best Admiralty large is 25s. There are several more definite orders in the market for America and Canada. Lower grade coals are, however, still irregular in price.

Dock Charges.

Mr. Finley A. Gibson, secretary to the General Committee of Traders' Representatives, has been in communication with Mr. Felix Pole, general manager of the Great Western Railway Company, regarding reductions in dock charges. Mr. Pole states that it is necessary that certain information should be prepared before a definite reply can be given respecting concessions, and he has promised to meet one or two members of the traders' deputation on the 28th inst. to discuss the matter.

Tin-plate Trade.

Tin-plate works are becoming better supplied with orders, and prices are steadier. Expectations are entertained that before long prices will advance.

Current Prices for Metals and Fuels.

IRON ORE.

N W. COAST—	
Native	25/-
(1) Spanish	25/-
(1) N. African	25/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	25/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	5 8 9	—
No. 1 Foundry	5 0 0	—
No. 3 Foundry	15 0	—
N.E. COAST—		
Hematite Mixed Nos.	4 14 0	4 11 0
No. 1	4 15 0	4 13 0
Cleveland—		
No. 1	4 15 0	4 15 0
Silicious Iron	4 15 0	4 15 0
No. 3 G.M.B.	4 10 0	4 10 0
No. 4 Foundry	4 7 6	4 7 6
No. 4 Forge	4 5 0	4 5 0
Mottled	4 0 0	4 0 0
White	4 0 0	4 0 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
Part Mine Forge	*None offering.*	
North Staffs. No. 3 F'dry	4 5 0 to 4 10 0	
(3) Northampton—		
Foundry Nos. 2 and 1	*Nominal.*	
,, No. 3	4 0 0	—
,, Forge	3 10 0 to 3 12 6	
(3) Derbyshire—		
No. 3 Foundry	4 0 0 to 4 2 6	
Forge	3 12 6 to 3 15 0	
(3) Licolnshire—		
Basic	4 0 0 to 4 5 0	
Foundry	4 5 0 to 4 10 0	
Forge	4 2 6 to 4 5 0	
(4) N.W. COAST—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	5 15 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 10 0	10 10 0
Best ,,	12 0 0	—
N.E. COAST—		
Crown Bars	12 0 0	—
Tees	10 10 0	—
LANCS.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	13 15 0
S. YORKS.—		
Crown Bars	12 0 0	—
Best ,,	13 0 0	—
Hoops	14 0 0	—
MIDLANDS—		
Crown Bars	11 0 0	—
Marked Bars (Staffs)	13 10 0	—
Nut and Bolts Bars	10 0 0	—
Gas Tube Strip	11 0 0 to 11 5 0	
Hoops (Nom.)	14 0 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	13 10 0	—
Ship Plates ⅜in. and up	10 0 0	—
Sections	9 10 0	—
Steel Sheets ⅛in. to ½in.	11 5 0	—
Sheets (Gal. Cor. 24 B.G.)	—	15 10 0

STEEL (*continued*)

N.E. COAST—	Home. £ s. d.	Export. £ s. d.
Ship Plates	10 0 0	9 0 0
Angles	9 10 0	—
Boiler Plates	13 10 0	—
Joists	10 0 0	8 10 0
Heavy Rails	9 10 0	—
Fish-plates	14 10 0	—
Channels	14 10 0	—
Hard Billets	8 15 0	—
Soft Billets	7 15 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 10 0	—
Light ,,	11 0 0 to 13 0 0	
Billets	9 5 0	—
Ship Plates	10 0 0	—
Boiler ,,	13 10 0	—
MANCHESTER—		
Bars (Round)	9 10 0 to 11 10 0	
,, (others)	10 10 0 to 11 10 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	9 10 0 to 11 0 0	
,, (Lancs. Boiler)	15 10 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Bessemer Billets	12 10 0	—
Hard Basic	8 15 0	—
Soft ,,	7 10 0 to 7 15 0	
Hoops	12 5 0	—
Soft Wire Rods	11 0 0	—
MIDLANDS—		
Small Rolled Bars	9 5 0 to 9 10 0	
Bessemer Billets	7 10 0	—
Hoops	11 10 0 to 12 0 0	
Gas Tube Strip	10 5 0 to 10 10 0	
Sheets (24 W.G.)	12 10 0	—
Galv. Sheets (f.o.b. L'pool)	16 0 0	—
Angles	9 10 0	—
Joists	10 0 0	—
Tees	10 10 0	—
Bridge and Tank Plates	10 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/6 to 19/9
Block Tin (cash)	155 2 6
,, (three months)	155 12 6
Copper (cash)	63 2 6
,, (three months)	63 8 9
Spanish Lead (cash)	24 17 6
,, (three months)	23 15 0
Spelter (cash)	29 5 0
,, (three months)	29 3 9
MANCHESTER—	
Copper, Best Selected Ingots	68 10 0
,, Electrolytic	70 10 0
,, Strong Sheets	94 0 0
,, Loco Tubes	0 1 1½
Brass Loco Tubes	0 0 11¾
,, Condenser	0 1 2¾
Lead, English	25 15 0
,, Foreign	24 5 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£27	10/-
,, 6 p.c. to 8 p.c. ,,	£25 10 0	9/-
,, 8 p.c. to 10 p.c. ,,	£24 10 0	8/-
,, Specially Refined		
Max. 2 p.c. carbon	£65	26/-
,, 1 p.c. ,,	£80	30/-
,, 0·75 p.c. carbon	£85	37/-
,, carbon free	1/1 per lb.	
Metallic Chromium	5/3 per lb.	
Ferro Manganese (per ton)	£15 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£13 0 0 scale unit	5/- per
,, ,, 75 p.c.	24 10 0 scale unit	6/- per
,, Vanadium	18/- per lb.	
,, Molybdenum	6/6 per lb	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£160	
Cobalt	11/- per lb	
Aluminium (per ton)	£110 to £120 (British Official.)	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	17/-
,, ,, Ell	17/6
,, ,, Splint	18/6 to 21/-
,, ,, Trebles	20/-
,, ,, Doubles	19/-
,, ,, Singles	18/3
AYRSHIRE—	
(f.o.b. Ports)—Steam	17/-
,, ,, Splint	19/-
,, ,, Trebles	20/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	17/6 to 21/-
Screened Navigation	26/-
Trebles	20/6
Doubles	20/-
Singles	18/9
LOTHIANS—	
(f.o.b. Leith)—Best Steam	18/9
Secondary Steam	17/9
Trebles	20/6
Doubles	19/6
Singles	18/6

ENGLAND.

(8) N.W. COAST—	
Steams	33/-
Household	40/- to 61/-
Coke	34/-
NORTHUMBERLAND—	
Best Steams	23/- to 24/-
Second Steams	20/6 to 21/-
Steam Smalls	15/- to 17/
Unscreened	20/6
Household	25/- to 28/-
DURHAM—	
Best Gas	21/6 to 22/-
Second	19/- to 20/6
Household	25/- to 28/-
Foundry Coke	30/- to 35/-
SHEFFIELD—	INLAND.
S. Yorks. Best Steam Hards	21/- to 22/-
Derbyshire Hards	20/- to 21/-
Seconds	18/- to 20/-
Cobbles	17/- to 19/-
Nuts	16/- to 18/-
Washed Smalls	11/- to 11/-
Best Hard Slacks	12/- to 13/-
Seconds ,,	9/- to 10/6
Soft Nutty ,,	7/6 to 8/6
Pea ,,	7/- to 8/-
Small ,,	2/- to 4/6
House, Branch	30/- to 33/-
,, Best Silkstone	27/6 to 29/-
Blast Furnace Coke (Inland and Export)	19/- to 21/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	24/- to 24/6
Second ,, ,,	23/9 to 24/-
Best Dry Large	24/- to 24/6
Ordinary Dry Large	23/- to 24/-
Best Black Vein Large	24/- to 24/6
Western Valley ,,	23/6 to 24/-
Best Eastern Valley Large	23/6 to 24/-
Ordinary ,, ,,	22/- to 23/-
Best Steam Smalls	17/6 to 18/6
Ordinary ,,	15/- to 17/-
Washed Nuts	22/6 to 24/-
No. 3 Rhondda Large	26/- to 27/-
,, ,, Smalls	18/- to 19/-
No. 2 ,, Large	22/- to 22/6
,, ,, Through	18/6 to 19/6
,, ,, Smalls	14/- to 15/-
Coke (export)	35/- to 37/-
Patent Fuel	24/6 to 27/-
Pitwood (ex ship)	31/9 to 32/6
SWANSEA—	
Anthracite Coals:	
Best Large	52/6 to 55/-
Seconds	40/- to 45/-
Red Vein	30/- to 32/6
Big Vein	42/6 to 47/6
Machine-made Cobbles	62/6 to 65/-
Nuts	60/- to 62/6
Beans	37/6 to 40/-
Peas	23/- to 25/-
Breaker Duff	8/- to 8/6
Rubbly Culm	15/- to 15/6
Steam Coals:	
Large	21/- to 23/-
Seconds	20/- to 21/-
Smalls	14/- to 15/-
Cargo Through	18/- to 20/-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b for export. (9) Per ton f.o.b.

French Engineering Notes.

(*From our Correspondent in Paris.*)

Electrical Distribution.

THERE are so many schemes being proposed and put in hand for the distribution of electrical energy, either from hydraulic sources or from the centres of coal supply, that the Government has found it necessary to organise the whole system so as to ensure a regular distribution, and at the same time prevent the formation of trusts and monopolies, the operations of which might be detrimental to the interests of consumers. A Bill has therefore been passed by the Senate authorising the creation of a network of high-tension mains all over the country, the various installations being connected up with each other so that one district may come to the assistance of another if required. The thermic plants in the Nord and the Est will, for example, help the hydro-electrical companies in the event of a partial failure of water supply, such as happened last year in some of the districts supplied from the Alps. The huge generating plants which are being put down in the colliery centres will not only supply the northern and eastern departments, but will also, on occasion, furnish energy to the hydro-electric mains. In 1918 it was estimated that the installations then existing in France had a capacity of 1,000,000 kilowatts, of which about 800,000 kilowatts were utilised. It is intended to double that capacity and provide for an additional 500,000 thermic kilowatts and 800,000 hydraulic kilowatts. The estimated cost is 15,000 million francs, of which one-third will be borne by the State, which will have control over the whole system. The scheme is intended to render the country independent of foreign coal supplies, and it was stated in the debate on the Bill that the above estimated cost would be covered by the saving in the purchase of coal abroad within six years. The preparation of the scheme began at a time when the cost of imported coal was so high that the French found themselves unable to bear the burden of the heavy financial charge, and now that prices have come down to such a level that French colliery owners are unable to sell their coal in competition, the necessity of carrying out the scheme is regarded as equally urgent, for unless the coal can be utilised at the pits for the production of electrical energy, it is not easy to see how owners can find a way out of their present difficulties, which are partly due to the high cost of transport, and more particularly to the wages and the diminished individual production. The men refuse to accept lower wages, and it is by no means certain that they will agree to the proposed temporary suspension of the eight hours law, whereby each man will be required to work an additional 300 hours a year without remuneration. The electrical distribution scheme is therefore expected at least partially to solve the problem; but like many other proposals its execution may be seriously retarded by the difficulty of finding the necessary funds.

Swiss-Ocean Railway.

The idea of opening up a direct line of traffic between Switzerland and the Atlantic has for many years been occupying attention, and by providing an overland route to Bordeaux there would appear to be every prospect of diverting traffic from Switzerland that at present goes by way of Genoa. It would constitute the most direct route between Central Europe and the American Continent. This and other projects that have remained in abeyance for so long a time are being taken up by the newly formed Conseil Supérieur des Chemins de Fer, which has already done useful work by giving partial satisfaction to the urgent claims of railway users over the question of rates, and the schemes, like the Swiss-Ocean Railway, are being examined with a view to their being put in hand as soon as the financial situation is sufficiently satisfactory. The Council has approved of the carrying out of the Swiss-Ocean Railway, and it will now be incorporated in a Bill to be presented to Parliament. The undertaking is not a particularly costly one, as some existing lines will be utilised, and the route taken will be from La Jonchère, near Limoges, to Commentry and Saint-Germain-des-Fossés.

Marseilles.

As is the case with most other ports, the situation at Marseilles was never so bad as it is at the present moment. Being dependent upon the world's shipping, it is suffering from the world-wide crisis. The docks are full of idle shipping, and at a time when everything appears to be paralysed by the unprecedented contraction of traffic, it is gratifying to see that the Marseilles Chamber of Commerce has been spurred to further exertions, and is doing everything possible to carry out its vast programme of harbour extensions. Unfortunately, the work can only proceed slowly, on account of the exhaustion of funds, but there is no actual stoppage of operations which will be accelerated as soon as the financial situation will permit of this being done. Marseilles has abundant hope in the future, for with the termination of the tunnel of Le Rove there will be a canal for barges of 1200 tons between Marseilles and Port de Bouc, which will deal with the traffic in coal, minerals and other bulky goods, leaving the docks at Marseilles free for merchant and passenger traffic. The programme will be eventually completed by the dredging of the canal of Coronte and the construction of miles of wharves between Port de Bouc and Martigue at each end of the canal, while the Etang de Berre will provide accommodation for any amount of tonnage.

Automatic Train Control.

Experiments continue to be carried out, at the instigation of the Minister of Public Works, with automatic apparatus for ensuring the safe working of railways. As accidents appear to have increased in proportion to the larger number of hands who had to be taken on to compensate for the shorter working hours, it is found that some reliable form of automatic control has become absolutely necessary, and it is reported that some satisfactory tests have been carried out on the Paris-Orleans line, with an apparatus known as the Rodolausse, which limits the speed of the locomotive, stops the train in the event of its passing a signal against it, and reduces the speed as required when passing the slowing down signals.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TRANSMISSION OF POWER.

181,097. June 6th, 1922.—CABLE FOR THE CONVEYANCE OF ELECTRICAL ENERGY WITH GRADUATED INSULATION, *Lovell Newton Reddie, of* 1, *Furnival-street, Holborn.*

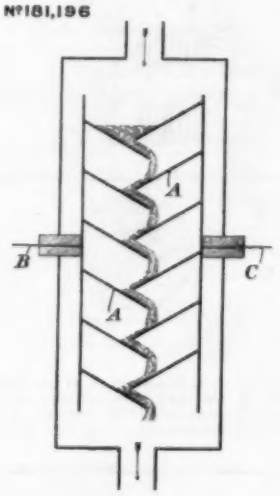
THE object of this invention is to provide a new type of high-tension cable insulated by means of impregnated paper, in which, from the conductor outwards, papers are employed of constantly increasing permeability. Owing to this graduation the insulation which is in immediate contact with the conductor possesses a high dielectric strength, while this strength diminishes towards the exterior layers. As, however, the exterior layers possess great permeability, they do not excessively prolong the duration of the impregnation of the cable.—*June 6th*, 1922.

LIGHTING AND HEATING.

181,196. April 22nd, 1921.—IMPROVEMENTS RELATING TO ELECTRIC HEATERS FOR LIQUIDS, Walter Hayhurst, of 8, St. James'-chambers, Accrington.

The liquid is heated in accordance with this invention by passing it between a series of inclined baffles A in the manner shown.

Nº 181,196



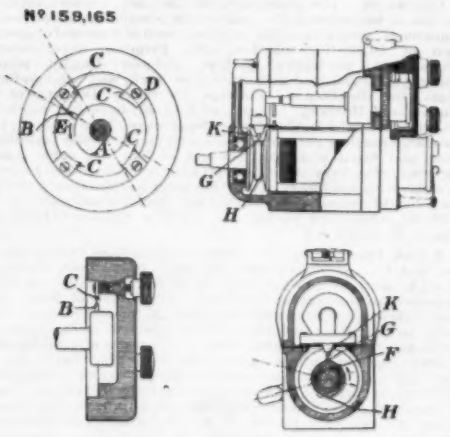
Current is passed through the baffles and liquid by way of the conductors B and C. Preferably alternating current is used.—*June 15th*, 1922.

MOTOR CARS AND ROAD TRAFFIC.

159,165. February 19th, 1920.—IMPROVEMENTS IN HIGH-TENSION ELECTRIC DEVICES FOR INTERNAL COMBUSTION ENGINES, Robert Bosch Aktiengesellschaft, of 4, Militärstrasse, Stuttgart, Germany.

This invention relates to ignition systems in which a series spark gap is provided for the purpose of increasing the sparking efficiency of the sparking plugs, and the object is to alter the length of the spark gap according to the engine speed. The rotating distributor A is provided with a sparking electrode B, and the stationary distributor disc D contains four electrodes C to which the cables leading to the sparking plugs are connected. It will be seen from the manner in which the electrodes C are shaped that if it is desired to change the length of the series spark gap the distributor disc D must be turned in the opposite

Nº 159,165



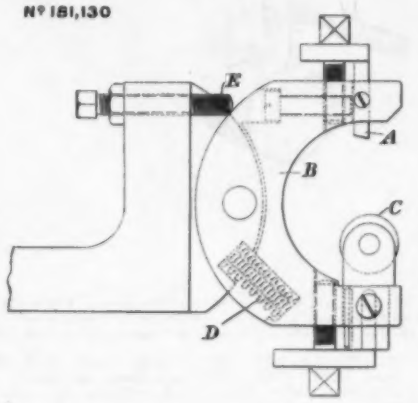
direction to that indicated by the arrow E. As, however, the spark transmission always occurs at the same place independently of the adjustment of the ignition time, the electrodes C may each be turned at right angles to the position shown, when, in order to alter the spark gap, the distributor disc must be displaced in the direction of the axis of the rotating part A. The latter arrangement is shown on the right. On the armature shaft a metal ring F is arranged which has peripheral extensions G H at two places opposite one another, and the friction carbon brush is replaced by a fixed sparking point K. The ring F is placed on the armature axis so that, in the position of the armature which corresponds to retarded ignition, the highest point of one of the extensions G H faces the point K, whilst in the position of the armature which corresponds to advanced ignition the low ring surface faces this point.—*May 29th*, 1922.

MACHINE TOOLS AND SHOP APPLIANCES.

181,130. March 10th, 1921.—LATHE TOOLS, J. Farren and Benton and Stone, Limited, Bracebridge-street, Birmingham.

This tool is intended for repetition work, and is claimed to produce work accurate to dimensions even if the lathe mandrel is slack in its bearings. The tool A is carried in a rocking holder B, which also has an adjustable roller C. A spring D tends to

Nº 181,130

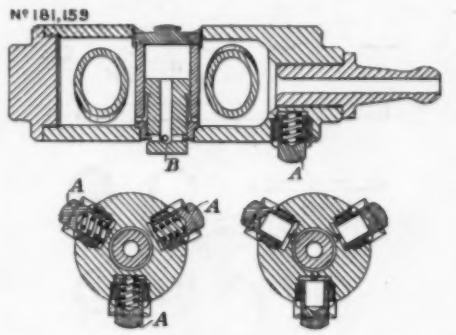


rock the holder upwards against a stop E. The distance between the roller and the tool determines the diameter of the work, while the rocking of the holder permits the tool to accommodate itself to any slackness of the mandrel.—*June 12th*, 1922.

181,159. March 29th, 1921.—PNEUMATIC SCALING TOOLS, F. Gilman, 9, Westfield-road, Edgbaston, Birmingham.

In this tube sealing device a series of centralising spring plungers A A is arranged in the rear part so that each plunger

Nº 181,159

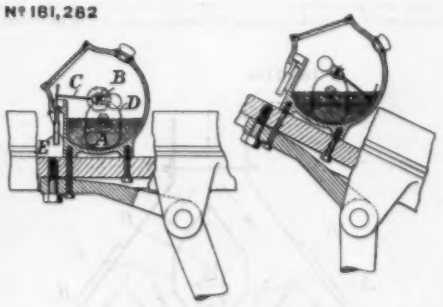


is in line with a corresponding hammer B. The result is that the plungers bear against the cleaned part of the tube and keep the tool truly central.—*June 15th*, 1922.

181,282. September 22nd, 1921.—LUBRICATORS FOR HACK SAWS, E. G. Herbert, Chapel-street, Levenshulme, Manchester.

This lubricator is fixed on the saw frame so that each time the saw is lifted out of the cut the lubricator has an angular movement. Inside the oil chamber there is a heavy pendulum A, which naturally hangs vertically. There is also a small axle B carrying a dipper arm C, which rests on the circular part D of the

Nº 181,282



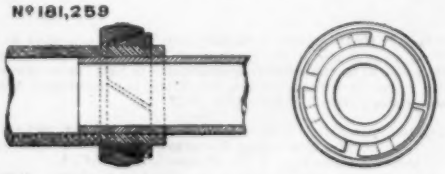
top of the pendulum. As the saw is lifted the axle B rolls on D and the dipper is immersed in the oil as shown in the right-hand view. When the saw is lowered again the dipper transfers a few drops of oil to the oil pipes E—see left.—*June 15th*, 1922.

MISCELLANEOUS.

181,259. July 27th, 1921.—HOSE CLIPS, S. H. Muffett and F. W. Moon, 44, Newton-road, Tunbridge Wells.

This hose clip is formed of two parts, an inner split conical

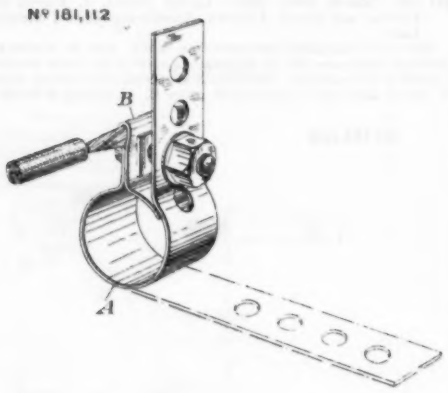
Nº 181,259



sleeve and an outer sleeve similarly coned. The two parts are screwed together, so that the split cone may be contracted, and it appears that the chief claim is for the use of a buttress type of

screw thread, the inventors claiming that such a thread reduces the effort necessary to screw the two parts together by 30 per cent.—*June 15th*, 1922.

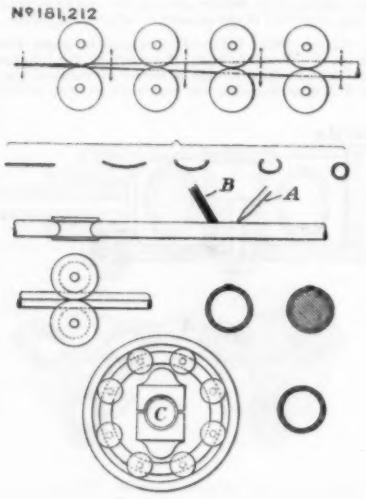
181,112. March 7th, 1921.—AN IMPROVED EARTHING AND BONDING CLIP FOR ELECTRIC CIRCUITS, Charles James Henry Stevens, of 27, Nadine-road, Charlton, London, S.E. 7. The earthing clip described in this specification is composed of



a ribbon or strip which is bent to form a loop A to embrace a conduit and also a loop B to embrace a bonding wire. The method of fixing the clip is self-explanatory.—*June 7th*, 1922.

181,212. May 4th, 1921.—MAKING ZINC TUBING, W. L. Woodward, 12,907, Clifton Boulevard, Lakewood, Ohio.

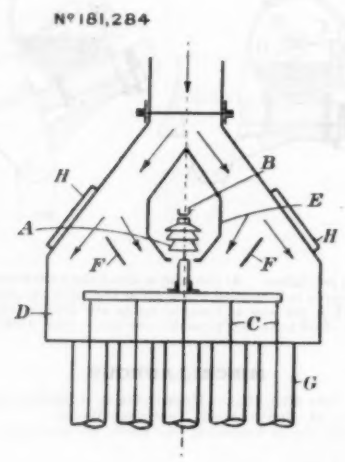
The inventor makes open-jointed zinc tubes by means of a rolling process, as shown in the upper views, and then welds the joint under a blow pipe A, while a wick B supplies the necessary



flux. This process leaves the joint very brittle, so he threads the tube over a mandrel C and hammers the joint in a swaging machine, as shown in the lower view, and thus renders the joint as ductile as the remainder of the tube.—*June 15th*, 1922.

181,284. September 23rd, 1921.—INSULATOR FOR THE ELECTRODES OF ELECTRICAL GAS PURIFIERS, *The Lodge Fume Company, Limited, of* 51, *Great Charles-street, Birmingham.*

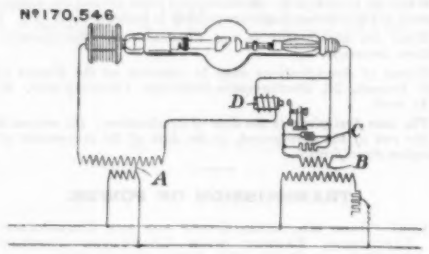
The insulators A, which carry the current conducting system B of the discharge electrodes C, are arranged inside the gas main D and are provided with an arched protective casing E, the lateral walls of which serve at the same time as gas distributing



surfaces. Guide plates or baffles may also be provided at F. Doors are provided in the gas main at H. Even if the discharge electrodes C or the collecting electrodes G have to be sprayed with water the water cannot reach the hot insulators A and cause them to crack.—*June 15th*, 1922.

170,546. April 4th, 1921.—IMPROVEMENTS IN AND RELATING TO ELECTRON DISCHARGE APPARATUS, *The British Thomson-Houston Company, of* 83, *Cannon-street, E.C.* 4.

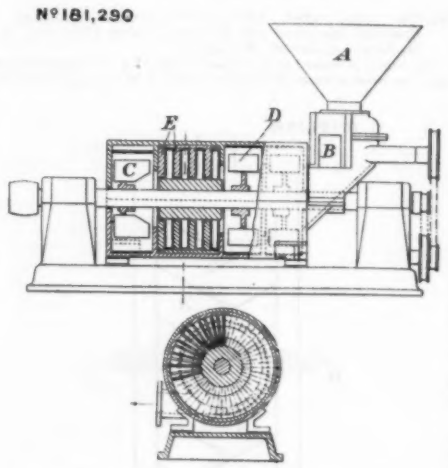
According to this invention an electron discharge tube is caused to operate in accordance with any desired characteristic curve by varying the electron emissivity of the cathode by means of a regulating device controlled by the current passing through the tube between the main electrodes. In the drawing an X-ray tube is shown, but the invention is not confined to this class of tube. The tube, it will be noticed, is supplied through a transformer A. There is also a second transformer B, which is shunted by a resistance C, and the regulation is performed by



an adjustable make-and-break device, the relative duration of the period of "make" as compared with that of the "break" being determined by the strength of the current flowing through the electro-magnet D.—*June 15th*, 1922.

181,290. June 27th, 1921.—COAL PULVERISERS, *The Powdered Fuel Plant Company, Limited*, 47, *Victoria-street, Westminster.*

In this pulveriser the coal is introduced at the hopper A and air at the inlet B, while the mixture of the two is withdrawn by the fan C. The coal is first subjected to a preliminary breaking



by the rotary hammer-type pulverisers D and then passes on to the section E. In this part there are sets of vanes rotating between fixed vanes, with very little clearance, and in it the coal is reduced to a very fine powder.—*June 15th*, 1922.

Catalogues.

HYATT, Limited, 56, Victoria-street, S.W. 1.—General industrial catalogue just issued; also one on roller bearings and their application to automobiles. Complete lists of bearings for varying loads at varying speeds with remarks on the most suitable type of bearing to employ for a given application are included in the pamphlets.

CLEWORTH, WHEAL AND CO., Limited, Grange Engineering Works, Trows-lane, Castleton, near Manchester, ask us to state that their recent publication on "Wet and Dry Bulb Thermometer" is now out of print, but that copies will be forwarded to applicants as soon as a fresh supply is received from the printers.

WATTS, FINCHAM AND CO., Limited, 22, Billiter-street, E.C. 3.—Three additional pages have been issued for the firm's general catalogue:—E 4A, The "Wefco" Charging Board; S 34A, The "Wefco" Gas Ejector; S 34B, The "Wefco" Water Ejector for Bilges, Cofferdams, Ballast Tanks, &c.

CONTRACTS.—The Spearing Boiler Company, Limited, informs us that it has secured the contract for a complete boiler-house equipment, consisting of three boilers, each of a normal evaporation of 50,000 lb., together with Ferguson superheaters, economisers, mechanical stokers, induced draught plant, chimneys, steam, feed and other pipe work, and ash-handling plant, for the Stepney Borough Electricity Department.—Ruston and Hornsby, Limited, of Lincoln, have just received an order from the Public Works Department, New Zealand, for two large dragline excavators, mounted on caterpillar travelling gear, and fitted with 65ft. jib and bucket of 2 cubic yards capacity, after very strong competition from American makers of excavating machinery. A further order has also been received for a No. 10 crane navvy mounted on caterpillar travelling gear, with 1¼ cubic yard bucket, for the New Plymouth Harbour Board, New Zealand.

A NEW PISTON RING.—We have received from Clews, Petersen and Co., of Blackburn-road, West Hampstead, London, N.W. 6, a sample piston ring made by the process briefly described in our patent specifications columns of May 19th last. These rings have two convolutions, but are made in one piece, so that their springiness is not affected by the joint, as is the case with some double rings. The process of manufacture is very ingenious and involves turning the ring inside out, a fact which shows that they must be made of excellent material. Each ring is parted off, from a pot, in the lathe by two cuts. One of the cuts does not make a complete circle, as it has to be stopped where the two convolutions of the ring join. The other cut separates the ring from the stock. In this condition there is a gap between the two convolutions, on account of the width of the parting tool, so the ring is turned inside out and stretched to give it a permanent set. When it is turned the right way out again the two convolutions naturally close tight against one another. The ring is then hammered on the inside in the usual manner to give it the spring necessary to make a tight joint against the cylinder. The ring is, of course, ground to size on the rubbing faces. The sample we have before us is a very nice piece of work and is made of a cast iron which is remarkable for its spring. The makers say that only one of these rings is necessary with a new engine to make the piston quite tight, while two rings will serve in an old engine which has become considerably worn.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

HIGHLAND AND AGRICULTURAL SOCIETY OF SCOTLAND.—Ninety-first annual Show at Dumfries.

SATURDAY, JULY 22ND.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Southern District meeting at Basingstoke Town Hall. 10.30 a.m.

MONDAY, JULY 24TH.

ROYAL METEOROLOGICAL SOCIETY.—Royal Society, 22, George-street, Edinburgh. Papers: (1) "Observations of Upper Cloud Drift as an Aid to Research and to Weather Forecasting," by Mr. C. K. M. Douglas; (2) "Note on the Effect of a Coast Line on Precipitation," by Mr. J. S. Dines; (3) "Note on Turbulence," illustrated by smoke and cloud photographs, by Dr. A. E. M. Geddes and Mr. G. A. Clarke, who will also exhibit a series of cirrus and cirro-cumulus cloud photographs. An exhibition of representative meteorological instruments will be on view in the rooms of the Royal Society. 3 p.m.

WEDNESDAY TO FRIDAY, SEPTEMBER 20TH TO 22ND.

THE INSTITUTE OF METALS.—Swansea. Annual autumn meeting.

EDUCATIONAL INTELLIGENCE.

THE following is the Honours List for the Final Examination for the B.Sc. Degree in Engineering at the University of Bristol:—First-class Honours in Civil Engineering: John Bernard Cook, Harry Reep Lintern, Thomas Nisbet, George William Rickard, Dev Datt Sharma; First-class Honours in Mechanical Engineering: Alfred James Jones, Reginald Sydney Thorpe, Frederick Bonse Tucker; First-class Honours in Electrical Engineering: Frederick Thomas Britton, Edward Cecil Cork, Eric Ernest Howell, Francis Baliol Wrightson; Second-class Honours in Civil Engineering, First Division: Alfred Alleyne Fursdon, Vivian Dottin Joll; Second Division, Om Prakash Gupta; Second-class Honours in Electrical Engineering, First Division: Ernest Hatfield Cribb, William Thomas Palmer; Second Division: Ernest Frederick Michael, Eric John Parnall, John Curtice Uglow.

THE following awards in the Faculty of Engineering have been made at University College, London:—Jews' Commemoration Scholarship (for the student of one year's standing, not being medical, who is most distinguished by general proficiency and good conduct): D. I. Comino. Andrews Scholarship (second year): B. W. Huntsman. Goldsmid Entrance Scholarships (second year): J. W. Ball, D. H. W. Channon, P. Hall. Archibald P. Head Medal and Prize: W. G. Jennings. L. F. Vernon-Harcourt Prize (Civil Engineering): A. S. Hartshorn. Chadwick Medal and Prize: D. G. Hanney. Diplomas in Engineering have been obtained by the following:—Civil and Municipal: C. A. Andrews, K. C. Bakhle, F. Batterbury, C. J. Chaplin, H. S. Cotterill, A. J. Farrington, J. K. Fisher, R. F. B. Grundy, D. G. Hanney, A. S. Hartshorn, J. Lunn, K. C. H. Montgomery-Smith, C. H. L. Needham, H. E. R. Polden, V. W. Roskilly, H. Stephenson, Avice Trevelyan, P. M. Walker; Mechanical: W. T. Bamford, A. E. Hewitt, W. G. Jennings, J. R. Smerdon; Electrical: N. Axford, L. T. Bird, A. J. Emery, A. N. Jackson, W. F. Marriage, D. C. North, W. J. Webb.

LAUNCHES AND TRIAL TRIPS.

VOLENDAM; built by Harland and Wolff, Limited, to the order of Holland-America Line; dimensions, 550ft. by 67ft. by 45ft.; 15,000 gross tonnage. Engines, two sets single-reduction geared turbines of Brown-Curtis type; total G.H.P. of 7500; constructed by the builders; 300 first-class, 380 second-class, and 1300 third-class passengers and emigrants; also 60 *en suite* first-class cabins; launch, Thursday, July 6th.

SCOTTISH STRATH; oil tank steamer; built by Sir W. G. Armstrong, Whitworth and Co., Limited, to the order of Tankers, Limited, London; dimensions, 440ft. by 57ft. 6in. by 33ft. 11in.; to carry 10,000 tons deadweight on mean draught of 26ft. 3in. Engines, triple-expansion, pressure 200 lb.; constructed by the builders; boilers supplied by Babcock and Wilcox; trial trip, Tuesday, July 11th.

CHICAGO TRIBUNE; cargo steamer; built by Swan, Hunter and Wigham Richardson, Limited, to the order of the Ontario Paper Company, Limited; dimensions, 250ft. by 43ft. by 19ft. 4in.; to carry 2300 tons deadweight. Engines, triple-expansion, pressure 180 lb.; constructed by the North-Eastern Marine Engineering Company, Limited; trial trip, July 1st.

ESPERANCE BAY; liner; built by Wm. Beardmore and Co., Limited, to the order of Australian Commonwealth Government; to carry 13,850 tons. Engines, two sets Parsons' turbines; constructed by the builders; trial trip, Tuesday, July 11th.

TYRRHENIA; Cunard liner; built by Wm. Beardmore and Co., Limited, to the order of Cunard Line; dimensions, 580ft. by 70ft.; 17,000 gross tonnage. Engines constructed by the builders; 265 first-class, 370 second-class and large number of third-class passengers; recently completed.

SUPPLY OF WATER TO STEAM WAGONS.—It will be recollected that in January last the Conjoint Committee, composed of representatives of the British Waterworks Association and of Associations of Motor Users and Manufacturers, offered a premium for the best design for a lock mechanism, including a token and key, for the supply of water by the roadside to steam wagons and road engines. A number of designs and models was received, and the Conjoint Committee awarded the premium to Mr. A. R. U. Heath, M.I.A.E., of Bexley Heath, Kent. The Conjoint Committee is now prepared to receive tenders from firms of lock and stamping manufacturers, manufacturing engineers and founders, for the construction of a specimen mechanism, and for the subsequent supply of the necessary quantity required by the water undertakings in the country who may adopt the scheme. Conditions of tender and drawings of the mechanism may be inspected at the offices of Mr. J. R. Davidson, M.Sc., M. Inst. C.E., water engineer, Liverpool Corporation, Alexandra-buildings, 55, Dale-street, Liverpool; Mr. Fred J. Dixon, M. Inst. C.E., M.I. Mech. E., Engineer-in-Chief, South Staffordshire Waterworks Company, 26A, Paradise-street, Birmingham; or the secretary, British Waterworks Association, Metropolitan Water Board Offices, 173, Rosebery-avenue, London, E.C. 1.

Accurate End Measurement on Measuring Machines Using a Screw.

By HENRY BAKER, M.Sc.

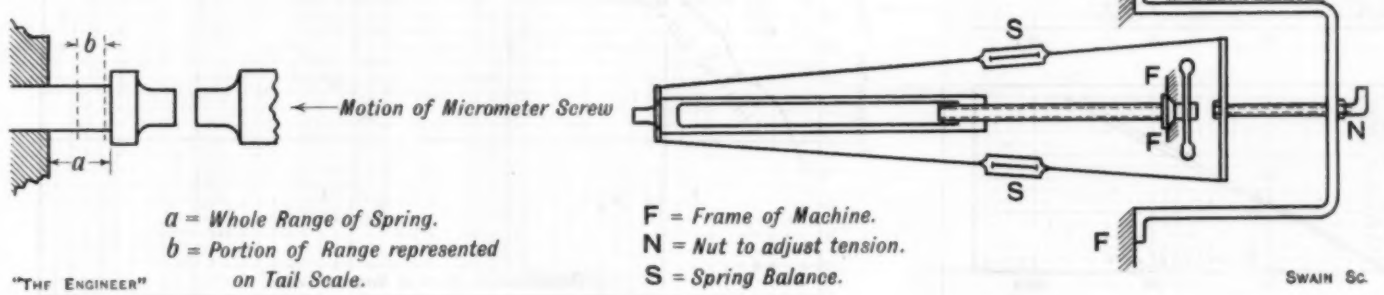
IT is hoped that the experiments recorded will be of considerable value to users of measuring machines, both on account of some of the theories which have been disproved and on that of showing the method of obtaining an accuracy of measurement somewhat greater than that usually employed. For both scientific work and practical work it is necessary to measure to a high degree of accuracy. Ordinary workshop gauges must usually be accurate to one-quarter of a thousandth of an inch. Consequently, master gauges should be correct to one ten-thousandth, and the machines which measure the master gauges must be correct to one or two hundred-thousandths. The experiments described below relate to attempts to measure correctly to one ten-thousandth of a millimetre, almost exactly equal to .4 of a hundred-thousandth of an inch, or, roughly, half of one hundred-thousandth. This unit will henceforth be referred to as one "a." Thus a = .0001 mm. = .000004in. approx.

The difficulty commonly experienced when using high precision measuring machines is to get them to "repeat." That is to say, to give the same zero readings on different days, or at least to give the same results for the size of a specimen on different days. Up to three figures of decimals, when reading in millimetres, the figures will usually repeat, but the fourth figure is found to vary.

MACHINE USED.

The machine used for the investigation was the "High Precision Micrometer" of the Société Genevoise d'Instruments de Physique, to take 100 mm., in the possession of the University of Birmingham.

The principle of the machine is the same as that of the ordinary screw micrometer, but the makers claim for it extreme accuracy and care in construction.



a = *Whole Range of Spring.*
b = *Portion of Range represented on Tail Scale.*

"THE ENGINEER"

FIG. 1

F = *Frame of Machine.*
N = *Nut to adjust tension.*
S = *Spring Balance.*

SWAIN Sc.

FIG. 2

The micrometer screw has a pitch of 1 mm. The graduated wheel is divided into 1000 parts giving a reading to the naked eye of .001 mm. There are a vernier and lens fitted, which enable a reading of .0001 mm. to be made quite definitely. In fact, as far as reading the micrometer head is concerned, it is easy to estimate to one-half of this quantity.

To ensure that the same pressure is applied when measuring different objects, or object and zero, and to enable the face of the tail piece to be brought to exactly the same place each time, an amplifying needle is incorporated with the machine, which magnifies the motion of the face of the tail piece or tail anvil 500 times. Thus for a motion of a of the tail anvil face the corresponding needle movement is .05 mm. With a low power microscope this movement can be very clearly observed. It was found that the motion of the needle was quite continuous and not of the nature of isolated jerks even for the smallest variations. A microscope with 2in. objective was used for observing the position of the tail needle, and a somewhat more powerful lens than the one supplied with the machine was found to be more convenient for reading the vernier.

The needle connected to the tail-measuring face moves over a scale having divisions each made to represent .001 mm., but in the measurements which follow, these divisions were not used, and the needle was always set to identically the same zero and the measurement made entirely dependent upon the micrometer screw.

A trial was made to see whether it was possible to move the tail anvil without moving the tail needle. The head anvil was moved up just to touch the tail anvil and bring the needle to zero. Then by careful tapping the head anvil was advanced by very small amounts. By exercising care it was found to be possible to advance the head by as little as ¼ a, but all movements were faithfully reflected in the tail needle.

A rough preliminary experiment was also made to note the effect of touching the machine with the hands. The tail needle was set to zero and observed while one hand was placed on the measuring terminals. The needle immediately began to move, and within a few seconds indicated a variation of between 30 and 40 a, due to the warmth of the hand causing expansion. The pointer returned nearly to zero in about 15 min. The hand was then placed upon the base of the "U" portion of the frame. Within a few seconds the pointer indicated a variation of 20 a. It was thus at once evident that the bare hands could not be used, and a pair of wool-lined gloves was worn for succeeding experiments.

The whole of the experiments were made at the University of Birmingham, and as the effect of small temperature variations had been foreseen, the room used for the storage of the measuring machine was specially built for the purpose and designed to avoid any rapid fluctuations. The room is one brick thick and possesses one door and two small ventilators. It is situated in the centre of a group of workshops, so that the outside of the room is only subjected to gradual changes of temperature and the inside to still more gradual ones. Illumination is by incandescent electric lamp near the roof, about 12ft. from the ground, and portable incandescent lamp (only used as required).

FIRST MEASUREMENTS.

The gauges used by the workshop are of the "+" and "−" type, and are in the form of circular rings, except the smaller ones, which are turned cone-wise out of solid. For a preliminary measurement the $^9/_{16}$in. + gauge was chosen, and it was decided to measure its diameter at one spot only—namely, when the figures (which are etched on the cylindrical portion) were vertical. This did not, at first, prove to be easy to accomplish. The first readings varied by about 10 a, and were not regarded as satisfactory. It was thought that some of the variation might be due to radiation from the body and from the lamp in the ceiling. It was decided to be necessary in future to take all readings with the specimen and measuring points covered up. A cotton covering cloth was found and used for the purpose.

The specimen was again measured and the positions of the needle at both the zero and specimen readings were checked by "re-setting." That is to say, the tail needle was displaced by means of the micrometer screw and subsequently brought back again to zero and any difference of reading noted. On this occasion there was no alteration of reading due to this kind of "re-setting," and it was decided to try whether the measuring faces could be re-opened, re-wiped and replaced without alteration of the reading. The actual results obtained were (temperature, 60.5 deg. Fah.):—

	mm.
Zero	− .0018
Faces cleaned and re-set zero	− .0015
Faces cleaned and re-set zero	− .0020
Faces cleaned and re-set zero	− .0022
Faces cleaned and re-set zero	− .0024
Faces cleaned and re-set zero	− .0025
Faces cleaned and re-set zero	− .0024
Faces cleaned and re-set zero	− .0024½

At first it was thought that the measuring faces might be actually worn away by the continued wiping, but this possibility was dismissed as being highly improbable. The variations were ascribed to dirt or dust, although the cleaning had apparently been thorough in each case. A series of similar readings was obtained with the specimen inserted. The conclusion arrived at at the end of these readings was that the arrangements for wiping the specimen and measuring faces were not satisfactory. It will be seen that, on wiping, the faces were apparently clean at − .0025 mm. (reading), but that further wiping apparently dirtied them again. It was thought that this must be due to fibres falling from the cotton wiping and covering cloths, and it was consequently resolved to try wiping with wash leather, moistened with ether as required, and to cover the machine with a silk cloth, or a piece of morocco leather, which was used for some readings. Later, a large piece of wash leather was used, and was found to be fairly satisfactory, although bits occasionally fell from it.

The new method of wiping at first appeared to have solved the chief difficulties, but another set of readings, following the most careful cleaning, again gave results showing an effect of the nature of "settling," which could not be attributed to the gradual removal of a film of dirt. The actual results were:—

	mm.
Zero (as found) at beginning	− .0052
Re-set	− .0055
Re-set	− .0056½
Re-set	− .0058
Re-set	− .0058
Wiped and re-set	− .0059½
Re-set	− .0059½

The machine was then left for two hours, and then a further set of disappointing readings followed. It was thought that the machine was being affected by heat from the hands even through the gloves, and it was determined to use only forceps for handling the specimen and cleaning rags, &c. Even the measurements using forceps only, however, formed a disappointing series. Apparently there was still trouble with dirt, even after the most careful cleaning. After many trials, both with ether-damped and dry wash leather, and also with clean paper, and with various methods of wiping, the results remained very variable. At length a careful exmination of the measuring faces with a high-powered pocket lens and mirror revealed the particles of dirt, and it was found possible to remove them with a penknife. After this point the term "clean" must be taken to mean first a thorough rubbing with dry wash leather, then a touch with ether-moistened wash leather, then a careful inspection by microscope and mirror and any remaining particles removed by penknife or glass sucking tube.

After fully cleaning as described above and inspecting all surfaces concerned very carefully, the results still appeared to be erratic. By chance another cause of error was discovered at a fairly early stage. The checking of pressure exerted on the specimen is performed by a tail pointer, as previously described, but the limits of the spring are greater than the pointer scale. A sketch, very much exaggerated in length, is shown in Fig. 1 to explain this.

It was found that if the micrometer screw was advanced until nearly the end of the spring range the reading at zero was permanently altered. At first it was difficult to explain this, but the cause was found to lie in the nature of the mechanism operating the needle. If the tail anvil is displaced by the full amount *a*, then the knife edges are lifted out of contact and, on coming back into position, take up slightly different positions. If, however, the needle is just brought up to the zero each time it remains constant in a very reliable manner.

Having discovered some of the most important errors, it was next decided to see whether a small alteration in the position of the specimen caused a variation of the reading, or, in other words, whether the specimen was cylindrical and the measuring faces flat.

The results were that by moving the specimen the diameter measured appeared to vary from 14.3140 to 14.3146. The specimen was apparently a truncated cone. The first nineteen measurements taken of the diameter considered of the $^9/_{16}$in. gauge were 14.3151 mm., 14.3145 mm., 14.3144 mm., 14.3145 mm., 14.3146 mm., 14.3147 mm., 14.3155 mm., 14.3124 mm., 14.3149 mm., 14.3141 mm., 14.3146 mm., 14.3141 mm., 14.3140 mm., 14.3144 mm., 14.3150 mm., 14.3143 mm. The variation in these results must be ascribed to a variety of causes.

MEASUREMENTS ON SECOND GAUGE.

The second gauge measured was a flat gauge, .170in. thick. The finish was good, enabling dirt to be seen readily. The position measured was always the same, namely, the middle of the portion below the etched size (when the specimen stood so that the figures were right way up).

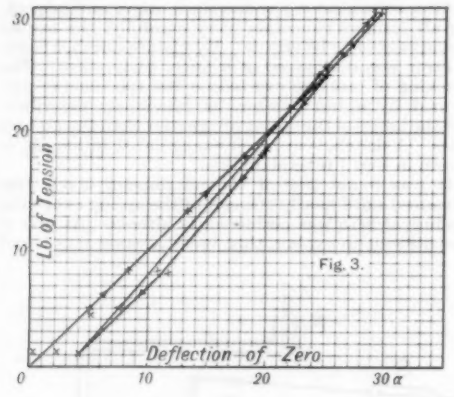
The results at first were very good, the thickness being measured as follows, each size being obtained from a series of readings similar to those illustrated in the earlier examples. In every case at least two different zero readings were taken, one before and one after the specimen was inserted. A number of re-settings were made for each reading.

Temperature.	Size mm.
13.5 deg. Cent.	4.3171½
	4.3171
	4.3171
14.5 deg. Cent.	4.3171½
16 deg. Cent.	4.3171

During these readings the zero points and specimen had appeared to "settle" in about two minutes, the usual amount of "settlement" being less than α. Then followed a series of disappointing readings :—

Temperature.	Size, mm.
12.8 deg. Cent.	4.3171½
	4.3172½
	4.3169½
	4.3169
14.6 deg. Cent.	4.3166½
15.4 deg. Cent.	4.3169
	4.3172
	4.3170
	4.3170½
	4.3170½

During these readings large fluctuations appeared to take place during the process of "settling." It was at first difficult to account for this, but it was thought that it might be due to wear taking place in the micrometer screw and a filling of the space by viscous oil. Inquiries on the wear taking place in similar machines were made, but the answers showed that very little wear usually took place. On the other hand, the turning of the micrometer screw was decidedly easier than it had been at first. This led to the conclusion that the variation must be due to a different condition of the oil in the micrometer screw. As the machine had not been used for a long time prior to the present investigator's first experiments, it was thought that the oil must then have been somewhat gummy, and that subsequent use



FIGS. 3, 4 AND 5

had stirred it up into a more liquid condition, which permitted of more ready settling of the screw.

EXPERIMENTS ON OIL FILM IN MICROMETER SCREW.

Preliminary experiments were made by hand, stressing the screw in different directions. It was found by this means that the position of the screw was not positive, but that it was "floating" on an apparently elastic film. To test this conclusion further a piece of apparatus was constructed to put a known tension on the micrometer screw. The apparatus was in principle as shown in Fig. 2. By means of this apparatus any tension up to 30 lb. could be applied, and the tension could be rapidly taken off when it was necessary to turn the hand wheel to obtain a different reading.

The results of applying and removing the load of 30 lb. are shown in the graph, Fig. 3. It may be noted that the calculated compression of the metal due to the load would be about 6 α. The recorded compression was 28 α. Thus it was thought that the compression must have been due chiefly to the effect of the oil film on the screw. It will be noted that this behaves very nearly as a perfectly elastic material. From the result of the test it was decided to attempt a series of measurements at 20 lb. pressure. This was done, but the "settling" was not reduced to any considerable extent.

MEASUREMENTS UNDER 20 LB. TENSION ON SCREW.

The flat specimen measured earlier during the investigation was not available at the time of making these measurements. Consequently an examination was made of all the smaller cylindrical gauges, and it was found that the "½in. +" gauge was the most nearly correct in shape. This gauge was accurately positioned by suspension from a fibre, the fibre being movable in any direction by means of a special piece of apparatus above the machine. By this means errors due to inaccuracy of the gauge and want of flatness of the measuring faces was reduced to a minimum. An error of not more than plus or minus half of α may be assigned to this cause.

The first readings were as follows :—

Gauge	12.7218, temp. 16.3 deg. Cent.
9 min. later	12.7217
Zero	T .9945†
3 min. later	T .9946†
Gauge	12.7212*
Zero	T .9945†
Gauge	12.7216
9 min. later	12.7216
Zero	T .9946†
Size of gauge	12.7271

* The presence of the reading marked with the asterisk cannot be accounted for.
† For T read minus one.

A later series of readings at 20 lb. pressure exhibited a curious effect. It was decided to try the effect of tapping the micrometer screw backwards. A light tap had no effect, but a slightly greater one began to move the screw backwards. This continued for about 30 α, when equilibrium was reached. Later work, however, appeared to show that this result was less due to displacement of the screw than to displacement of the knife edges of the amplifying device at the machine tail.

MEASUREMENTS WITH 30 LB. SPRING.

A number of further observations were taken under 30 lb. pressure, resulting in the following sizes being recorded :—

12.7271 at	16.6 deg. Cent.
12.7272½ at	16.6 deg. Cent.
12.7273½ at	14.4 deg. Cent.
12.7273½ at	14.0 deg. Cent.
12.7273½ at	14.6 deg. Cent.

Despite the considerable increase in tension, the screw still appeared to "float" on a film of oil, which gave a second curve—Fig. 4—exhibiting almost perfect elastic properties.

This condition of affairs was regarded as being too indeterminate for reliable working, and consequently it was decided to remove the screw and wipe both it and the nut and all bearing surfaces quite clean and dry. This was, accordingly, done, and the machine re-assembled.

EXPERIMENTS WITH SCREW DRY.

A series of readings with varying tensions applied to the screw was now taken, and it was anticipated that the variation would be of an elastic nature with a maximum deflection of 6 α, and with, perhaps, a little preliminary deflection of a non-elastic character. These anticipations were shown to be completely wrong, the actual curve obtained being shown in Fig. 5. This curve shows a similar deflection to that which included the effect of the oil film. The only conclusion to be drawn from this is that the elastic deflection of the frame of the machine is very much greater than might have been expected, and that this, together with the elastic deflection of the anvil and screw make up the observed effects. The oil film effect appears to be uniform and, therefore, negligible. There was, however, another possible defect of the machine revealed by using the screw perfectly dry, for by this means it was discovered that the alignment effected by the cup and cone thrust bearing of the screw spindle was not perfect It was possible, by careful tapping, to obtain equilibrium about 2 α to the right or left of the "normal" position. Attempts were made to take readings at one or other of these extreme positions, but as they were not quite stable it was found to be more reliable to use the "normal" position. In the majority of cases the "normal" position repeats itself identically, but there is always a possibility of occasional error here, and, consequently, one reading alone can never be absolutely reliable.

The following measurements were taken with the screw dry and using extreme readings :—

12.7278 at	14.1 deg. Cent.
12.7276 at	14.6 deg. Cent.
12.7279 at	14.3 deg. Cent.

These readings would be reduced by about 4 α each to reduce to "normal" readings, but in any case they are erratic and considerably higher than other readings. After these experiments the screw was carefully lubricated with a thin neutral oil and the thrust cones carefully adjusted.

ABNORMAL READINGS.

One of the chief difficulties, up to this point, was to account for the occasional very abnormal readings. A series of observations made to examine these phenomena and, if possible, repeat them, was then undertaken. The phenomena would not, at first, recur, but it was eventually discovered that they could be caused by a heavy tapping of the machine, particularly of the measuring anvils.

At an early stage it was found that a smart tap with a light instrument assisted the process of "settling" the machine, and this method was, accordingly, used. Later, the results appeared to be best when the micrometer screw anvil was lightly tapped backwards (*i.e.*, against the working flank of the screw). Experiment showed that if the tapping be done somewhat harder the measurements became

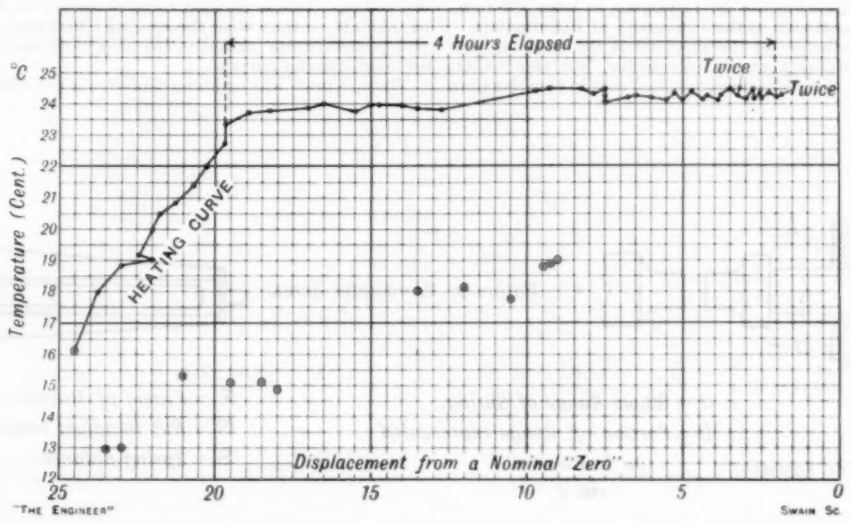


FIG. 6

unstable. This is probably due to inertia effects in the multiplying comparator at the tail of the machine causing the knife edges to get out of contact momentarily and to take up new positions on returning. For later readings tapping was not resorted to.

SETTLING.

Throughout the experiments a certain amount of "settling" had always been observed. That is to say, that if the pointer of the machine was brought up to a certain point—usually zero—it would not remain there, but would gradually fall away by a certain amount, sometimes as small as half of α, and sometimes as great as 3, 4, or even 5 α. The most usual amount was from 1 to 2 α. The cause of this settling was very difficult to trace. At first it was thought to be due to the oil film on the screw settling, and though, no doubt, this has some effect, it appears to be no more than ½ of α. That it was not the sole cause of settling was shown by the fact that settling took place under increased pressure on the screw and even when the screw was perfectly dry.

Another hypothesis was that the settling might be due to the gradual exclusion of air from between the measuring anvils or the anvils and specimen. This must occur to some extent, but it appears to be of less amount than ½ α, or to take place in less time than one minute, *i.e.*, before a reading can be taken. The evidence against this as a cause of the observed settling is, first, that the observed settling did not appear to be effected by the difference between a flat specimen giving surface contact and a cylindrical specimen giving line contact; and, secondly, that once the machine had "settled," in many cases the jaws could be opened and closed again without altering the reading (*i.e.*, without requiring a new period of settling).

The cause of the settling must be attributed to changes in temperature of the various parts of the machine. These come under three different heads. First, there is the change of size of the machine as a whole with temperature. This is due to the different

coefficients of expansion of the cast iron frame and the steel measuring anvils, and also to the differing elasticity of the frame with temperature, which causes a sagging or otherwise of the parts supported by it. Settling due to this cause can be neglected if the observations are taken rapidly, as the effect is very slow compared with the rate of observed settling; if, however, the observations occupy some time, as is usually the case, then apparent settling due to this cause must be taken into account. The correction for this change was determined, for the machine used, to be almost exactly 1½ μ per degree Centigrade—a fairly large correction. Secondly, there is the effect of a sudden rise of temperature of one part of the machine due to handling, radiation from the body, and the like. This can be avoided by careful handling, or, if caused, can be accounted for. The third cause is the heating up of the nut and screw of the measuring machine due to friction between them and to friction at the thrust cones. This effect might be thought to be small, so an experiment was made to determine its magnitude. It was found that fairly rapid turning through 12 mm. and back caused a rise of temperature sufficient to cause a variation of reading of 5½ μ—greater than any observed settling. Slow movement of the screw results in elimination of settling, as far as it can be seen without disturbing the setting, but on re-setting a further settlement of ½ to 1 μ usually occurs after an interval of about 15 min.; it is, however, much safer to leave one hour before taking a final reading.

RESULTS.

The following readings show the results obtained on the ½in. + gauge. No compensation was made for temperature effect on the frame of the machine, as the readings were taken "direct." That is to say, a zero reading and a specimen reading was taken in each case, the one at a fairly short interval after the other. The abnormal readings, previously referred to, have been omitted.

Size. mm.	Temperature. deg. Cent.
12.7271	16.3
12.7272	15.8
12.7271	16.6
12.7272½	16.6
12.7273½	14.4
12.7273½	14.0
12.7273½	14.6
12.7273	15.9
12.7272½	15.0
12.7272	15.1
12.7271	15.1
12.7271½	12.9
12.7271	13.0
12.7272	Average

It will be seen that the difference between the smallest and the largest readings is only 2½ μ, or, almost exactly, one hundred-thousandth of an inch. Thus, by exercising care, readings to this degree of accuracy can be taken in an ordinary room not exposed to direct sunlight or to draughts. To obtain results correct to one "μ" consistently some control must be exercised over the temperature variations of the room, as, owing to the small temperature "head" between the air and the machine, a changing temperature causes the machine temperature to lag behind the room temperature by a considerable amount, and will effect readings unless they are taken very rapidly. If, however, the readings are taken rapidly, the heating of the screw due to friction vitiates the results by an amount equal to one or two μ, so that the only safe course to pursue is to keep the room temperature constant to within half a degree (Centigrade) for some time before measurement and during the period of measuring. The accompanying graph—Fig. 6—shows the very irregular nature of temperature effects. The curve shows the effect on the zero reading of heating up the measuring room slowly. The points enclosed in circles show the value of the zero reading as found on various occasions. Zero is not constant at any given temperature unless that temperature has been steady for four hours in advance of the reading being taken.

Further readings taken at fairly constant temperatures were:—

Size.	Deg. Cent.
12.7271	13.0
12.7272	19.0
12.7271	18.9
12.7271½	16.1
12.7270½	15.5

CONCLUSIONS.

As far as variation of measurement is concerned, the machine in question has been proved to be absolutely reliable to ½ μ, and to show fairly well a variation of ¼ μ, or, roughly, one millionth of an inch. The only difficulties encountered in noting the variations of ¼ μ were that the lines on the measuring drum were rather broad, and that the vernier was not suitably divided, and also that the focus of both scale and tail pointer was not coincident.

The accuracy of measuring the size of an object with the machine cannot be accomplished to the above accuracy of ¼ μ. The observed variation of ¼ μ measures, in addition to the size of the object, the errors in machine alignment, temperature errors due to variation of room temperature and radiation from the body, hands, &c., temperature errors due to friction in the measuring screw, and errors in aligning the object in the machine.

In a room kept away from direct sunlight and direct radiation of heat and protected from draughts it is possible to measure correctly to ± 1 μ. That is to say, no two readings will vary more than 2 μ. This represents the highest degree of accuracy attainable without special refinements. The following are the conditions which must be fulfilled in order to attain the standard of accuracy of ± 1 μ:—

(1) The temperature of the room must have been constant to ½ deg. Cent. for four hours before the measurements begin.

(2) Either the specimen used must be geometrically accurate (*e.g.*, flat or cylindrical) to less than ¼ μ, or the alignment of the specimen must be absolutely identical every time it is measured.

(3) Both specimen faces and measuring faces must be perfectly clean, and no dirt must be visible under scrutiny with a four-power microscope. If either specimen or machine have to be rubbed or handled to get them clean they must be left for at least two hours before measurements are made.

(4) While taking measurements the machine must not be touched or breathed upon. If the hands are warm gloves should be used. The body should not approach nearer than 1ft. to the machine, and should remain close to it for as short a period as possible.

(5) The temperature in the measuring room must not vary more than ½ deg. Cent., except for very short periods while measurements are being made.

(6) If the screw has to be moved more than three revolutions when taking readings the machine should be left for at least one hour to settle.

(7) In machines of this type, having a tail amplifier, the tail pointer should never be brought more than one or two divisions beyond the centre or zero position.

To facilitate working it has been found desirable:—

(1) Never to allow the tail pointer to be pushed off its scale, even when cleaning.

(2) Never to alter the zero reading, but to keep a "zero history" of the machine. This facilitates the discovery of dirt or oil or any other disturbing cause.

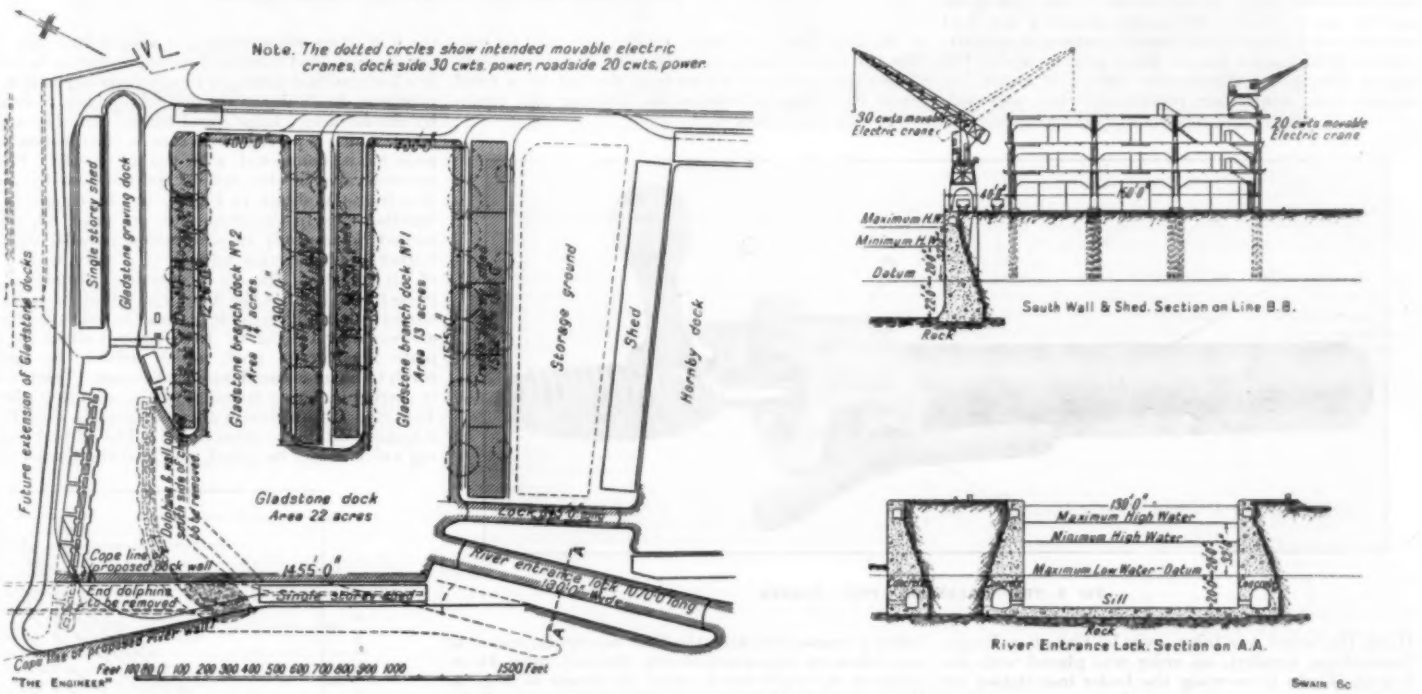
(3) To establish a table of corrections for zero reading at different temperatures to be used in conjunction with the "zero history."

Dock Extensions at Liverpool.

THE Mersey Docks and Harbour Board is at present engaged on work of considerable magnitude and importance in connection with the port of Liverpool, which, when completed, will add materially to the capacity and efficiency of that great system, and will enable the Gladstone graving dock—the largest of its kind in the world, and built to take a type of ship which no longer uses the port—to be operated to greater advantage than hitherto. We give herewith a plan which shows the extent of the development scheme, and on page 92 a number of photographic representations of the work during construction. Hitherto the Gladstone graving dock has been approached direct from the river, and that has necessitated a long channel on which a large amount of money had to be expended annually for dredging to keep it open. This entrance is to be closed and the graving dock is to be made part of a new system of docks comprising a large dock of 22 acres and two new branch docks, shown on the plan, of 13 acres and 11¾ acres area respectively. The whole will be approached by means of a new river entrance lock 1070ft. long and 130ft. wide, which will not be so exposed as is the present entrance to the Gladstone graving dock. A cross section of the lock is also given in our engraving. The work of constructing this lock is well advanced, as will be seen from the views on page 92.

The sill of the new lock will be 20ft. below the bay datum. The effect of the work will be this:—The depth of water on the sills at low water on the ordinary spring tides will be 21ft. 4in.; at low water, ordinary neap tides, 28ft. 7in.; and half-tide level, 35ft.; at high water, ordinary neap tides, 41ft. 7in.; and at high water, ordinary spring tides, 48ft. 10in. Apart from the fact that this entrance will enable the largest ships that have ever been constructed to go in and out on every tide, ordinary trading ships coming to the port will be able to go in and out of dock at absolutely any time of any day except for a very small number of hours each side of low water on the spring tides.

In addition to the new river entrance lock, a new and smaller lock has already been constructed, 645ft. long by 90ft. wide, which connects the Gladstone docks with the existing Hornby dock. The new branch docks will be provided with treble and double-storey sheds, the largest of which will be 1502ft. long by 150ft. wide, with two lines of rails running along each side, and a complete system of movable electric


Note. The dotted circles show intended movable electric cranes, dock side 30 cwts. power, roadside 20 cwts. power
Future extension of Gladstone docks
Single storey shed
Gladstone graving dock
Gladstone branch dock N°2 Area 11¾ acres
Gladstone branch dock N°1 Area 13 acres
Storage ground
Shed
Hornby dock
Gladstone dock Area 22 acres
Cope line of proposed dock wall
End dolphins to be removed
Simple sheer strut
River entrance lock 1070'0" long
Cope line of proposed river wall
Feet 100 0 100 200 300 400 500 600 700 800 900 1000 1500 feet
"THE ENGINEER"
30 cwts movable Electric crane
20 cwts movable Electric crane
Maximum H.W.
Minimum H.W.
Datum
Rock
South Wall & Shed. Section on Line B.B.
130'0"
Maximum High Water
Minimum High Water
Maximum Low Water - Datum
Sill
Rock
River Entrance Lock. Section on A.A.
Swain &c

PLAN AND SECTIONS SHOWING EXTENSIONS OF THE GLADSTONE DOCK

cranes—see the engraving. The sheds are being constructed of ferro-concrete, and they will be supported on ferro-concrete piles 50ft. long.

The whole of the work is being carried out by the Mersey Docks and Harbour Board under the supervision of Mr. T. M. Newell, M. Inst. C.E., the engineer-in-chief to the Board, who is responsible for the design of the scheme. The cost of the scheme will be about £6,000,000.

Foettinger Transformers on a Liner

No. II*.

EMPRESS OF AUSTRALIA.—OIL BURNERS.

THE machinery installation of the Canadian-Pacific liner the Empress of Australia is of interest, not alone on account of the turbines and transformers described and illustrated in our last article, but also because of the special features of the boiler equipment and oil-burning arrangements. In common with the general practice which has obtained for large German liners during the last ten years—and many of these ships have been taken over and are now operated by British shipping lines—water-tube boilers of a modified Yarrow design are installed. The arrangement of the fourteen boilers in their two boiler-rooms, and also the lay-out of the oil fuel tanks, may be seen in the plan of the ship included on page 689 of our issue of June 23rd. It will be noted that in each boiler-room three sets of boilers are placed back to back, whilst one is separate. The illustration at the top of page 85 shows the front view of one of the separate boilers. The upper drum is circular and the lower drums clearly shown in the view given are of the D form. Originally designed for coal burning, each boiler has a heating surface of approximately 3255 square feet, a grate area of about 172 square feet, and a superheater surface of about 775 square feet, whilst air preheaters were provided.

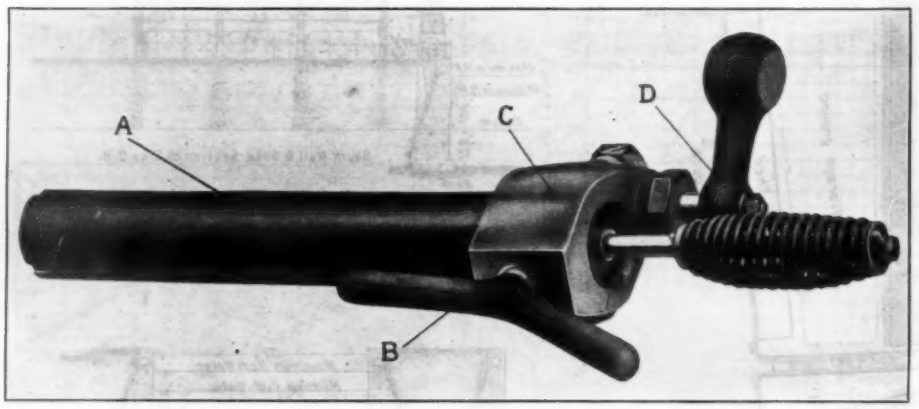


FIG. 4—THE VULCAN OIL FUEL BURNER

When the vessel was taken over by Canadian-Pacific Steamships, Limited, an order was placed with the Vulcan Works to re-equip the boiler installation for oil fuel burning, and to fit the Vulcan system of oil burners, which is also used on the company's sister ship the Empress of Scotland. The illustration on page 85 previously referred to, serves to show the general arrangement of the group of three burners on the boiler front. Figs. 4 and 5 show the burner itself and its details respectively, while Fig. 6 shows one of the fire doors. The curves reproduced in Fig. 7 indicate the amount of fuel oil burned by different sizes of nozzles when working at different pressures, and it is of interest to note that these results were obtained with coal tar oil heated to a temperature of 167 deg. Fah. Referring to Fig. 4, it will be seen that the burner proper is enclosed in the burner body C and the jacket A, where it is secured by a hand screw B, which determines its position and establishes a connection with the fuel oil supply, which is controlled by the quick-closing shut-off valve D, in addition to the control valve R shown in Fig. 6. When the valve D is moved to the right it cuts off the fuel, and if moved to the left it gives full supply.

As will be gathered from Fig. 5, the burner, which is interchangeable—spare burners are provided so that clean burners are always available—consists essentially of a long tube E furnished with a connection socket F and a handle G. The atomiser, which is carried at the extreme end, is made up of a cone K with a nozzle plate M and burner tip L, all of which are held in place by the cover nut I, which screws on to the burner tube E. A cast iron burner shield H is also provided. It fits on the end of the burner and prevents a disturbance of the flame by

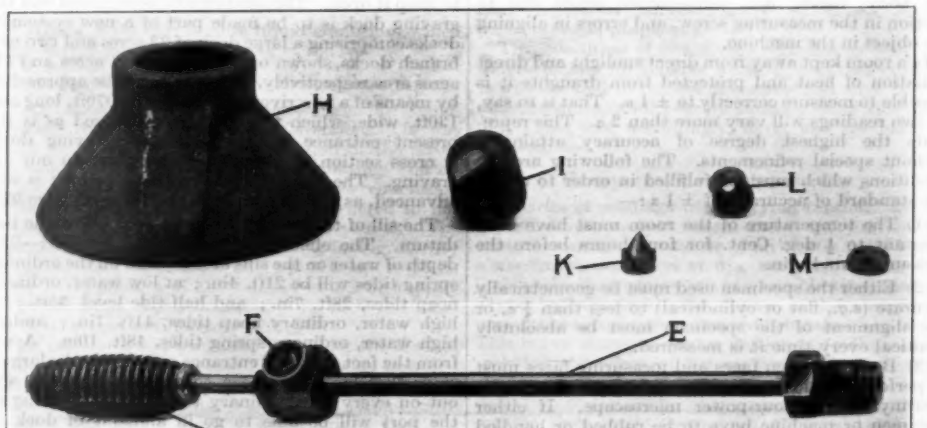


FIG. 5—DETAILS OF THE VULCAN BURNER

* No. I. appeared July 7th.

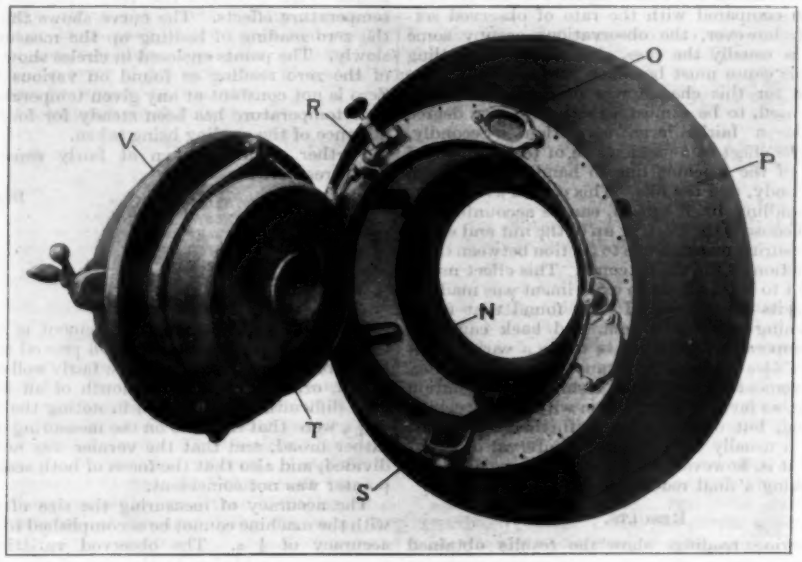


FIG. 6—FIRE-DOOR OF VULCAN OIL BURNING SYSTEM

the flow of air when running at very light loads. The handle at its end enables the burner unit to be moved in a longitudinal direction to any desired position, the necessary flexibility of the oil fuel pipe being obtained by means of two large spiral turns. Another adjustment, which is perhaps best seen in the illustration on page 85, is connected with the air supply. The air control valve is attached to the fire-door by means of a frame V shown in Fig. 6, and by means of two handles, seen in the front view on page 85, can be moved horizontally in a direction parallel with the burner. This device admits of a very wide range of air control. The air is entrained through radial ports in the front of the door, which may be opened or closed by turning the slide plate attached to the cooling air regulator T—Fig. 6. In its open position the slide plate uncovers a port, which allows the igniting torch to be introduced into the furnace. The fire-door is carried in a ring fastened to the adapting plate P. This ring is furnished with an inspection door O and a leakage oil filter connection S. The oil fuel regulating valve R will be noted, and also the burner shield

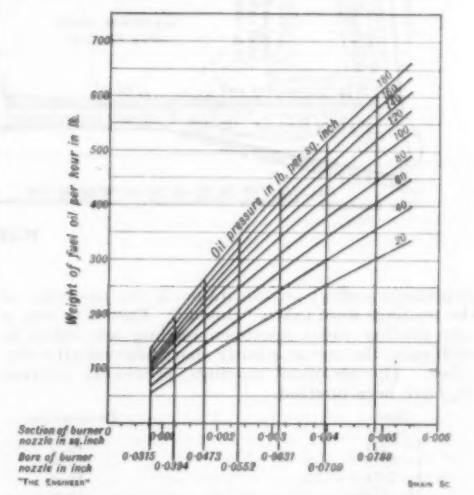
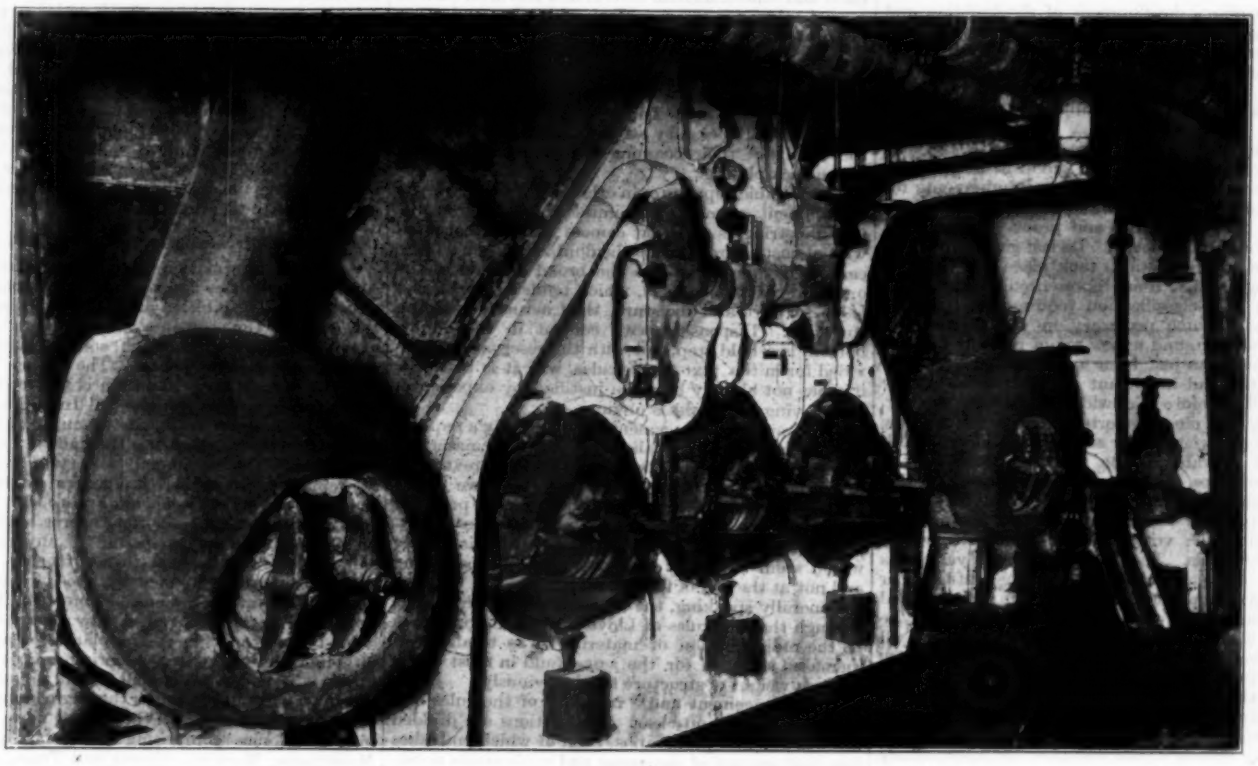

Weight of fuel oil per hour in lb.
Oil pressure in lb. per sq. inch
Section of burner nozzle in sq. inch
Bore of burner nozzle in inch
"THE ENGINEER"

FIG. 7—FUEL CONSUMED WITH DIFFERENT SIZED NOZZLES

and the perforated protecting shield. The interior of the adapting plate is fitted with a throat-like nozzle ring N, which, on being detached, gives access to the furnace. The fuel supply pipe being coiled round the hinge of the fire-door in the form of a long spiral spring, it is possible to swing back the door after the fuel supply has been shut off without breaking any fuel oil connection, and without altering any adjustment of the burner or air control previously made. A light cover is provided which can be inserted into the air nozzle ring when the door is for any reason opened. From the description given it will be appreciated that all adjustments are simple and easy to make, and the apparatus is characterised by great accessibility. With a view to avoiding shut downs due to a choked burner, spare burners, and simple tools and fittings for dismantling and cleaning are provided in each boiler-room.

The curves given in Fig 7 show the performance of the burner with varying sizes of nozzles, the nozzle plates being manufactured with bores varying in diameter from 0.0315 to 0.118 of an inch, these sizes

ONE OF THE OIL-FIRED BOILERS OF THE C.P.R. LINER EMPRESS OF AUSTRALIA



corresponding to a change in sectional area of from 0.001 square inches to 0.005 square inches. The oil pressure may be varied from about 14.5 lb. per square inch up to 215 lb. per square inch, and the system enables the amount of oil burned to be reduced to as low as 55 lb. per hour, which is advantageous, particularly for the slow heating required with cylindrical boilers.

PERFORMANCE OF THE MACHINERY.

The following extract from the trial results obtained in the North Sea when the vessel was handed over to the Reparations Commission will serve to indicate the performance of the machinery under average trial conditions.

Duration of trial	Six hours
Average boiler pressure	245 lb. per square inch
Average steam pressure at turbine nozzles	200 lb. per square inch
Steam temperature at nozzles	258 deg. Cent.
Vacuum at turbine exhaust	722 mm. of mercury
Percentage of barometric height	93.8 per cent.
Vacuum in condenser	730 mm. of mercury
Percentage of barometric height	94.8 per cent.
Revolutions of turbines	775.3 per minute
Revolutions of propeller	144.4 per minute
Ratio of speed reduction by transformer	5.37
Total shaft horse-power (two shafts)	14,830
Speed of transformer pumps	1840 revs. per minute
Pressure in transformer pumps	61 lb. per square inch
Preheating of feed water	82.5 deg. Cent.
Steam consumption of main turbines	12.6 lb. per S.H.P.

During these trials the feed water was measured by means of special nozzles built into the feed-water tanks. The exhaust steam from the auxiliary turbines was condensed in the auxiliary condenser and not delivered to the main turbine through the special automatic valve provided for this purpose. Had the exhaust steam been used in the main turbine it is expected that a reduction of about 5 per cent. on the steam consumption would have been thereby attained. From figures obtained from the tests of the first transformer which were made on the test bed at the Hamburg works of the Vulcan Company in 1913, the overall efficiency of the transformers under the aforementioned load and speed conditions is about 88 per cent., which does not take into consideration the gain of a further 2 per cent. due to the heating of the feed water in the transformers.

Now that the vessel has been equipped for oil burning and further experience has been gained in the operation of her propelling machinery even better results are awaited.

THE engineers of the Manitoba Power Company have announced that by Christmas of this year the first unit of the 170,000 horse-power development project at Grand Falls will be completed, and the power delivered in Winnipeg. This company is a subsidiary of the Winnipeg Electric Company, and the new hydro-electric project will, it is estimated, cost 7,500,000 dollars to complete, and will do much to provide for the electrical needs of the city of Winnipeg for years to come.

Concrete Cylindrical Bins for Coal Storage.

AMONG the many and varied classes of construction for which concrete is being used extensively in the United States are coal pockets or bins of the silo type for coal dealers and manufacturing plants. These concrete coal pockets of the silo type are cylindrical bins, built either of mass concrete, concrete blocks or vertical concrete staves. The coal is loaded into them by machinery and is discharged into wagons or trucks through gates in the side or bottom of the bin. This automatic delivery to storage and again to customers or for distribution effects a great saving in time and labour cost as compared with shovelling by hand. Pockets made of any material could be employed, but concrete is used most extensively, since it is cheap, fireproof and adapted to any situation. Insurance rates are lowest for concrete structures, and expenses for maintenance and depreciation are at a minimum, while the coal is housed and protected from the weather as well as from theft.

Modern coal yards or coal storage plants of this kind have one or more elevated storage bins, usually circular in shape—like farm silos or grain elevator bins—their height and diameter varying with the capacity required and the ground area available. The height ranges from 30ft. to as much as 60ft., and the diameter from 12ft. to 20ft. One bin can serve for different sizes or grades of coal if necessary, by means of interior partition walls.

Coal yards are situated usually near railway sidings, rails being laid to a concrete hopper or pit below the ground, so that coal can be discharged directly into this pit from drop-bottom railway wagons. Conveyors for carrying the coal from the track hopper to the bin are of two general types. In one case there is an endless chain equipped with flights of buckets, the chain of buckets rising vertically from a sump fed automatically from the hopper and then travelling horizontally over the bins, discharging the coal at any desired point. Such a plant needs to be supplemented by some device for lowering the coal into the bins in a slow and steady stream, in order to minimise breakage.

The other method is to use a coal bucket of about 2240 lb. capacity, handled by a mono-rail system which extends over the bin. This bucket is lowered into a pit beside the track hopper and is filled with coal by opening a gate. It is then hoisted, carried by the mono-rail trolley to the desired bin and then lowered, the bucket discharging automatically when it lands on the coal pile within the bin. For loading coal into wagons each bin, or each compartment of a subdivided bin, has an opening about 10ft. from the ground, fitted with a gate and a hinged inclined spout and screen. With this arrangement the lower portion of the bin is filled usually with earth or cinders. In some cases, however, the bin has a concrete bottom about 10ft. or 12ft. from the ground.

The designing of the bins needs to be done by competent engineers, in view of the pressures to be sustained. In monolithic construction, reinforced concrete walls are at least 6in. thick. Hollow concrete blocks for bins are made with curved faces and radial ends, so as to build up into a circular form. Steel reinforcing rods and rings are placed in recesses in the blocks, these recesses being filled with cement mortar as the blocks are laid in place. Bins and silos of stave construction are built up of vertical staves or slabs about 30in. high, 10in. wide and 3in. thick, the sides and ends being so shaped as to make tight joints. This stave construction is bound by steel hoops on the outside, drawn to a bearing by bolt and nut connections. Limitations for this stave type of construction are that the bins should not exceed 30ft. to 40ft. in height and should not be subdivided by interior partitions, as the structure is not adapted to sustaining the stresses due to unequal loading by having some compartments full and others empty.

For bituminous coal the capacity—at 40 cubic feet per ton of coal—is from 85 tons for a 12ft. bin, 30ft. deep, to 154 tons for a 14ft. bin, 40ft. high, 318 tons for an 18ft. bin, 50ft. high, and 468 tons for a bin 20ft. inside diameter with coal 60ft. deep. This matter of capacity is of importance in relation to cases where the yard space is limited. Thus three bins, 18ft. inside diameter and 60ft high, with coal 50ft. deep, will furnish storage for about 1000 tons of coal on a ground area 20ft. by 60ft.

POSITION OF FRENCH RAILWAYS.

A STATEMENT with regard to the present position of the French railways was recently made by Monsieur Le Trocquer, Minister of Public Works, in the course of which it was shown that a steady improvement is being made. Dealing first with the financial aspect, M. Le Trocquer said that in 1920 the deficit in the budget of the six principal systems amounted to 3 milliard francs; in 1921, it exceeded 2 milliard francs, but he had every reason to believe that this year it would be less than 1 milliard francs. The excess of receipts over estimates was also encouraging, since they exceeded 200 million francs, the Nord showing 40 millions above estimated receipts, and the Est the same sum.

A notable improvement had been made with regard to rolling stock. In July, 1914, there were 1720 locomotives, 4500 passenger carriages, and 15,000 trucks out of repair, In December, 1919, as the result of the war, these figures had increased to 3418 locomotives, 13,800 passenger carriages, and 59,300 trucks. To-day, these have been reduced to 2717 locomotives, 7764 passenger carriages, and 49,134 trucks. This improvement was partly due to the use which had been made of private industry. Before the war all repairs were carried out in the companies' repair shops; now a part is allotted to private firms, which last month repaired 103 locomotives, 783 passenger coaches, and 10,220 trucks. During the same month the railway repair shops dealt with 144 locomotives, 25,099 passenger coaches and 100,221 trucks.

With regard to measures for increasing the safety of railway travel, M. Le Trocquer stated that within a short time all the French railways would be provided with an electric apparatus which repeats on the engine the signals on the line, so that engine-drivers could no longer pass a signal without noticing it. Gas lighting on passenger trains was being replaced with electricity, thus reducing the risk of fire. The number of accidents had never been as low as at present; in 1913, out of every 100 million passengers there were eight deaths from accident. Last year the figure stood at 18.38 per 100 million, falling for the first six months of 1922 to 1.5.

M. Le Trocquer also said that he hoped in the future to see large metal coaches without wooden panelling, sleeping cars for second and third-class passengers, and, above all, the electrification of all the French railways. He considered that a continuous current of 1500 volts was most suitable for this purpose; it could be picked up from a third rail or from overhead. The P.L.M., Orleans and Midi systems were, he added, already electrifying a portion of their lines, and he estimated that twenty years hence all the lines south of the Loire would be operated electrically. In the north the matter was more difficult, as there was not the same water power available for the production of current.

The New Rules of Lloyd's Register of Shipping.

THE continuous development of shipbuilding and the ever-changing conditions of commerce, as affecting the structural design and construction of merchant ships, make it desirable that from time to time the regulations guiding the design and construction of such vessels should be the subject of revision and review.

The policy of the Committee of Lloyd's Register has always been to assist and guide in a wise and deliberate manner the classification requirements for ships and to keep abreast of, as in its new rules and tables, the latest scientific and practical aspects of ship design and construction. Its last general revision of the rules and regulations took place in 1909, and though they, at that time, represented an important advance in ship classification requirements, further revision had become necessary in the course of a dozen years or so, and a new set of rules and tables for steel ships has just been approved. They cover many distinct and important changes, and a review of these will therefore be of wide general interest.

Probably the most important feature of the new rules is the adoption, so far as is practicable in detail, of draught of water as the basis for obtaining the scantlings of ships. For the simple application of this principle, the soundness of which cannot be denied, two basic types of vessels are provided for, namely, "full scantling" vessels and "complete superstructure" vessels. The "full scantling" vessel has scantlings and arrangements which entitle her to the maximum draught that can be assigned for her dimensions, and to this type would be assigned, after compliance with the rules in all respects, the class 100 A1 certificate. The "complete superstructure" vessel has scantlings corresponding to the maximum draught when the freeboard depth is taken as at the deck or line of deck next below the "complete superstructure" deck. To vessels of this type and to vessels whose draughts are intermediate between those corresponding to the basic types would be assigned the Class 100 A1 "with freeboard." Other classifications provided for are for vessels intended for special service to scantlings as may be approved by the Committee, such as "for Channel service," "for coasting service," "for river service," and so on. To these classes are prefixed the letter "A." Thus the new rules provide, as hitherto, for all classes of ships.

The Committee has retained its well-known scantling numeral $L \times (B + D)$, but for certain parts of the vessel, as the side framing, now uses the depth (D) alone, instead of (B + D) as previously, while a new numeral $L \times D$ is applicable to side and bottom plating and double bottoms.

Coming now to the scantlings, we find that those for stems and stern frames appear to be similar to those in previous rules, except that, in pursuance of the principle of draught as basis for scantlings, the requirements for full scantling vessels differ from those for complete superstructure vessels. Probably the most important tables are those for side framing and topsides. In the former the depth (D) in association with span and spacing determines the scantlings; in the latter the numeral $L \times (B + D)$ is used. Both tables provide for all types of vessel ranging from flush deck ships to those whose lengths are completely covered by superstructures. The side framing tables are arranged for wider frame spacing than before, thus being in line with modern tendencies in this respect. Tables for topside scantlings include also those for single-deck vessels and vessels having decks below the strength deck, and for the scantlings of detached superstructures. The scantlings for decks are intended for abreast cargo hatchways or other deck openings, whose breadths are 40 or 50 per cent. of that of the deck, while for other breadths of opening, modifications to thickness of deck, within limits expressed in the rules, are provided for. Scantlings for the portions of the decks within line of deck openings are also given, and a table of adequate gunwale angles for strength decks completes the information. Knowing the moulded dimensions, proportion of length covered by superstructures and draught, these tables are simple and direct in application for the two most important structural items of the ship girder.

Another table of importance—indeed all the tables are important—is that providing for arrangements against panting, now first specifically detailed in the rules. The system embodied is the web frame system, which provides great strength and stiffness against panting, and probably better than any other system, while it dispenses with panting beams, thus giving to the shipowner as clear a hold as possible in this part of the vessel. Again, the scantlings of the double bottom are simply arranged, and here wisdom has been shown in having for most of the items a constant scantling fore and aft.

Vessels having single bottoms with open floors are provided for by tables of floors and keelsons.

The scantlings of deck beams are based, as before, on the beam of the ship in association with rows of pillar supports. Following the Beam Tables are arrangements of deck pillars and girders, including the well-known arrangement of deck girders having single or double bulb angles on their lower edges.

Another table of note is that for shell plating, giving scantlings for both the basic types.

The remaining tables of bulkheads, deep tanks and oil fuel tanks, hatchways, rudders, riveting and equipment and others, include several new features, such as special tables for the scantlings of bunker and other non-watertight bulkheads, tables for bulkheads for trawlers and tugs, and for the construction of oil fuel tanks, so many of which are now fitted in view of the great increase in the number of vessels arranged for oil burning in their boilers. Ventilators receive increased and necessary attention in connection with the details of their coaming plates and attachment to the deck plating.

Two notable departures in other respects are worthy of comment, namely, the omission of requirements for side stringers and that cement may be dispensed with almost entirely inside the double bottom. There can be no question as to the broad wisdom of the omission of side stringers, which tended to present a ledge for dirt and moisture, thus actually assisting corrosion. Dispensing with cement in the double bottom is a bold step, but with the reservations provided for in the text of the rules, will, it is believed, if it has not already been, be justified by experience. The saving of weight is obvious.

An admirable arrangement of the Society's requirements relating to the quality and testing of materials, collected under one heading, completes the text.

At the end of the rules for steel ships we notice another departure from previous general practice, namely, the application of the principle of interpolation; we suggest that the importance of this subject would seem to justify its mention at the beginning and not at the end of the rules.

Generally speaking, the broad principle which runs through the new rules of Lloyd's Register appears to be the redistribution of material so as to afford an increased strength for the same (and in most cases) for less weight of structure than previously.

The arrangement and "format" of the rules and tables is simple and clear. The sections are divided into clauses and paragraphs, each of which embodies just that amount of statement and explanation necessary for application by shipbuilders, naval architects and others interested. The rules retain a sufficient requisite of elasticity to make the practical carrying into effect of them by the surveyors to the Society free from the rigidity of "red tape." We await with interest the publication of the new rules for vessels intended to carry oil in bulk, which are stated to be at present under revision.

French Colonial Public Works.

(By our Correspondent in Paris.)

No. I.

THE policy which France has been pursuing for more than three years past is to afford an adequate protection to home industries and to render the country as far as possible independent of foreign supplies of raw material by obtaining all that is required from the colonies. Thus, colonial development has become a leading factor in French politics. Immediately after the Armistice a Commission was sent to West Africa to investigate the resources of the vast territories watered by the Niger, the Senegal and their tributaries, and the report was convincing in its conclusions that with the carrying out of suitable public works, the construction of roads and railways, the creation of ports, and the putting in hand of irrigation schemes, it would be possible for the colonies to supply France with more than she needed in the way of natural products such as cotton, wool, grain, timber, rubber, copra, arachides (ground-nuts), palm oil, and, in fact, nearly everything required for home consumption and for home industries.

As the result of the Commission's investigations the Minister of the Colonies, M. Sarraut, drew up a programme of public works involving an expenditure of several milliard francs, and a Bill approving of the scheme passed through the Chamber of Deputies. The works are being undertaken within the limits provided by the amount of funds available. These funds are, unfortunately, restricted by the country's financial difficulties, and except for Indo-China, which is particularly prosperous and is providing a good budget surplus, all the colonies have to rely upon outside aid, and while the State will eventually vote the necessary credits it is proposed, in some cases, to hasten forward the works by means of public loans, although such a contingency is dependent upon the programme being presented in such a way as to ensure its almost immediate commercial success. For the moment it is difficult to see what can be done except by the State. The progress so far made is much greater than might have been expected in view of the general financial position. In West Africa large sums of money have been spent upon opening up communication with the interior, and the roads and railways already constructed show that the French are not to be deterred by difficulties in preparing for the active development of Senegal and other territories reaching as far as the Sahara Desert.

It was with the idea of co-ordinating the work of colonial development that a Congress on Colonial Public Works was held recently in the Grand Palais at the Marseilles Exhibition, when it was decided that the only really satisfactory way of carrying out the works was to take them as a whole and form one programme, so that the work could be undertaken within the means available according to their importance in the different colonies. It was also suggested that the colonies should give mutual aid, as far as possible, in carrying out the undertakings. Indo-China would, for example, afford assistance to less favoured possessions. Several reports were presented upon the works necessary to be carried out in the colonies in order to permit of their active development, and the programme is so vast that the Congress found it necessary to constitute a Permanent Congress of Colonial Public Works, which will collect all the data necessary for the execution of the programme and issue a periodical publication.

THE MARSEILLES EXHIBITION.

As much information as is at present available concerning the development of the colonies is presented at the Exhibition at Marseilles, where each of the colonial Governments has a special "pavilion" of native architectural design, sometimes with native shops and encampments. The most wonderful building seen at any exhibition is the reconstruction of the Angkor-Vat temple in Indo-China. That colony is the only one, apart from Algeria and the Tunis Protectorate, where the industries are fully developed. The extent and variety of the resources are remarkable, but there is a general impression that they will not directly benefit France, for the reason that Indo-China finds markets nearer home, and the distance is too great to permit of any considerable supplies of raw material to the mother country if requirements can be met by the products of the newer African possessions. Moreover, Indo-China appears to work up most of its raw material, for which a good deal of machinery and plant are required, and although the country is suffering from the general crisis, it is nevertheless well worth the attention of machinery firms. So far as the engineering activities of France are concerned, there is far more to be done in the colonies comprising Senegal, Niger Valley, Mauretania, Morocco, Algeria and Tunis, which vast territories are regarded as a continuation of France. As the French commercial policy is always based upon political considerations the programme of communication aims at connecting up the whole of West and North Africa by roads and railways, while the final achievement, if the difficulties can be overcome, will be the construction of a line across the Sahara Desert to Timbuctoo. The character of much of the desert, with shifting sands, presents serious obstacles. The reports presented at the Congress make it clear that the laying down of railways will create traffic, but this can only be done in some territories by means of irrigation, which promises to become one of the big features of West African enterprise.

AN OFFER TO BRITISH EXHIBITORS.

The object of organising the particularly successful colonial exhibition at Marseilles was not only to interest the French public in the development of the colonies, but also to give French engineers and manufacturers an opportunity of showing what they could do to assist in the work of opening up the new territories. There is a rather extensive machine gallery and a section devoted to agricultural machinery, but there is very little indeed of direct interest to colonial buyers. We learn that the result is disappointing to the organisers, who admit that French makers have not laid themselves out to supply special colonial machinery, nor do they think that the French will ever be able to do much in that direction, as, owing to the comparatively limited market, they will not be able to compete with British and other firms who have a much wider field for the sale of their machines. As the exhibition opened with practically nothing in the way of machinery needed in the colonies the Committee attempted to create a special section for British manufacturers, but the proposal did not meet with sufficient support from British firms, who hesitated to go to the expense of maintaining exhibits for a period of eight months. But since the question of expense appears to be the only obstacle, the Committee is prepared to go into the question of placing a building at the disposal of British firms if a sufficient number will undertake to make a collective exhibit, not necessarily of machinery, but of photographs, models, catalogues in French, and literature of all kinds that will enable colonial buyers to judge of the suitability of the goods offered. If anything is to be done the collective exhibit must be ready early in September. Our inquiries at the exhibition left no doubt that the colonial companies and others are anxious to obtain as full data as possible concerning the machines for which they have a special need.

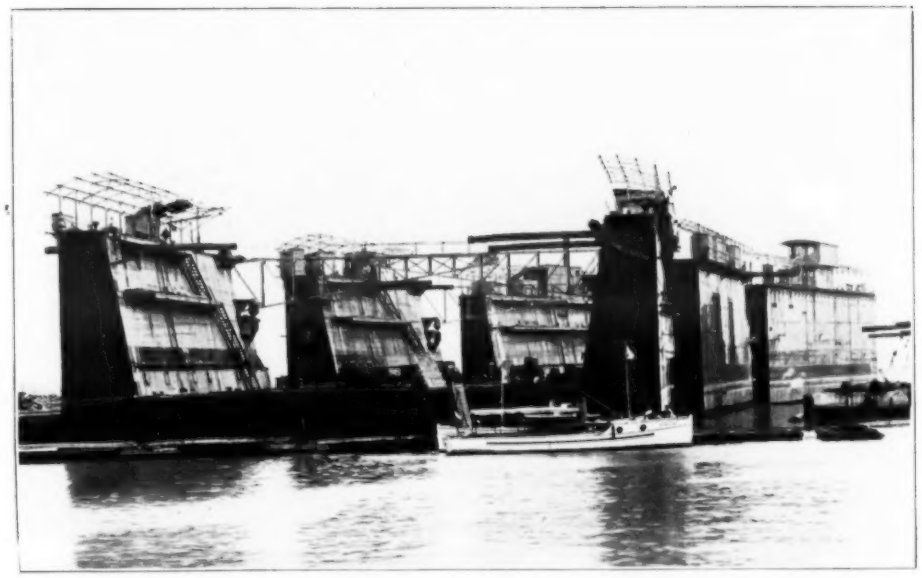
EASTER being in March last year affected the comparison of the goods traffic of March, 1922, with the corresponding period of 1921, and the results are less unfavourable than they would otherwise have been. General merchandise suffered a decrease of 5.1 per cent. in tonnage, whilst coal, coke and patent fuel enjoyed an increase of 20.3 per cent. The goods receipts were 3.7 per cent. down, and the goods train mileage experienced an increase of 2.2 per cent. Over 9 million more tons of coal were shipped for export and bunkers in the first quarter of this year than in that of 1921.

SELF-DOCKING A 14,000-TONS FLOATING DOCK

THE DRY DOCK COMPANY, SURABAYA, JAVA

GENERAL VIEW OF DOCK

INTERIOR OF DOCK

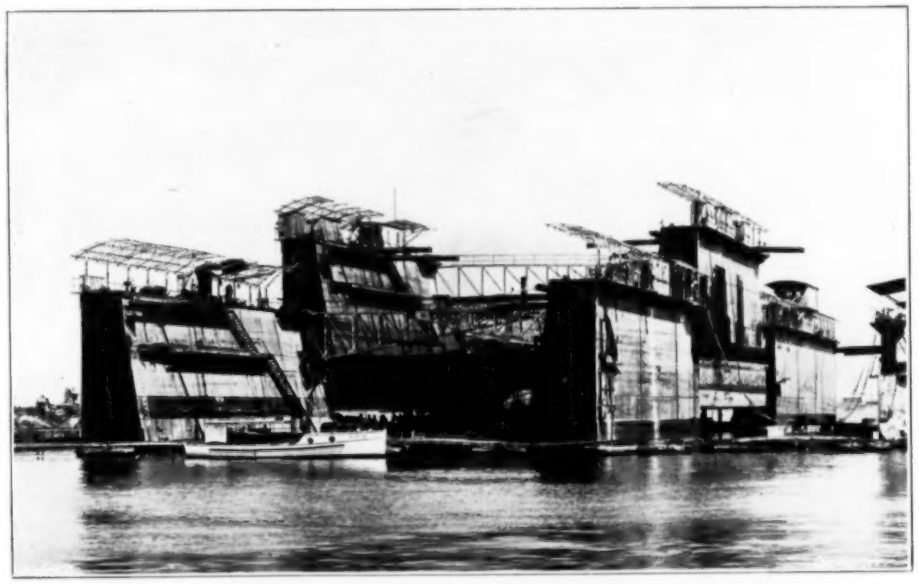


THE THREE SECTIONS UNCOUPLED

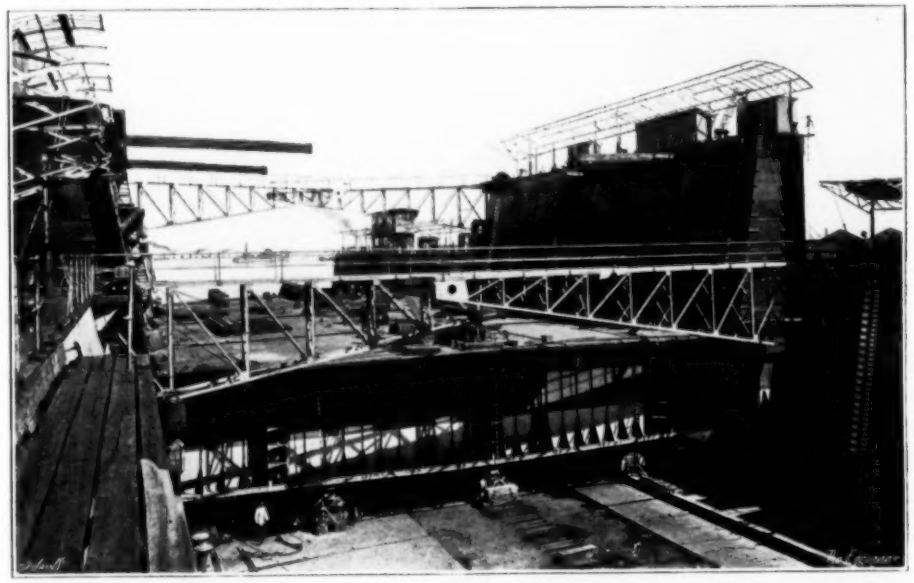
INTERIOR WITH SECTIONS UNCOUPLED

THE THREE SECTIONS UNCOUPLED

INTERIOR WITH SECTIONS UNCOUPLED

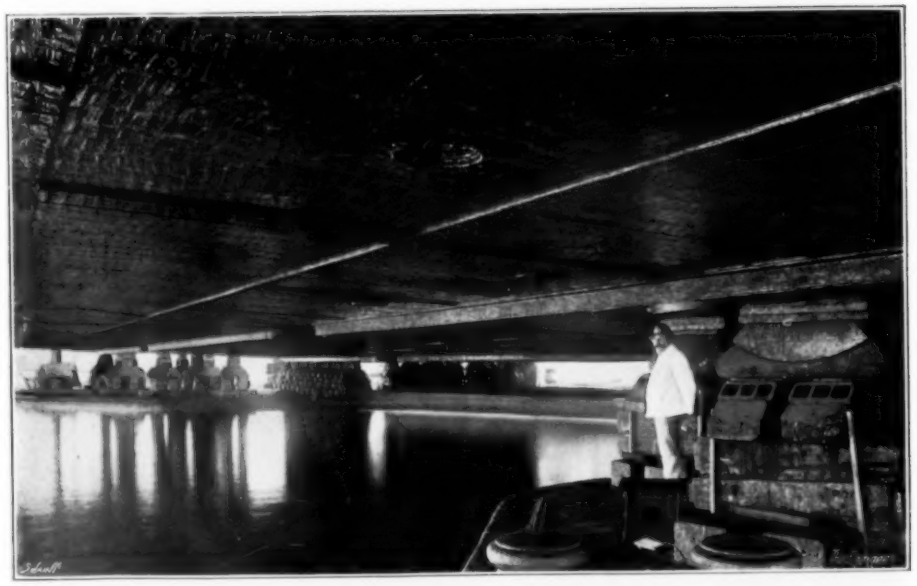


ONE SECTION RAISED



VIEW OF RAISED SECTION

UNDERSIDE SHOWING FOULING



UNDERSIDE CLEANED AND COATED

A Seven-Day Journal.

Next Year's International Air Conference.

THE Air Conferences organised by our Air Ministry, of which two have now been held, are domestic affairs so far as the British Empire is concerned. The Congrès International de la Navigation Aérienne held at Paris in November, 1921, was, on the other hand, the first of a series to be held in various countries, at which interested parties from all over the world may meet to discuss technical and scientific developments in aeronautics. The second of the series, it is announced, will be held in London next June. The Congress will be open to all countries which are signatories to the International Air Convention or are represented on the Fédération Aéronautique Internationale. It will last a week, and will involve the reading and discussion of papers, visits to aircraft factories and establishments and other functions. The Duke of York has consented to become President of the General Council of the Congress, and Lord Weir has accepted an invitation to become a Vice-president. The Air Ministry, the Post Office, and all the aeronautical organisations in this country will be represented on the Organising Committee.

A Telegraphic Jubilee.

ON Monday of this week the Eastern Associated Telegraph Companies celebrated their fiftieth anniversary, for it is fifty years ago since the Eastern Telegraph Company, under the commercial guidance of the late Sir John Pender—the father of the present chairman—incorporated half a dozen other companies, and thus extended its service to all parts of the world, except North America. The Associated Companies now control about 130,000 miles of cable. Since the Armistice they have laid 28,000 miles of cable at a cost of nearly £12,000,000, which works out at about £430 per mile, as compared with the pre-war rate of about £200. The early days of submarine telegraphy were full of excitement and romance, for in the 'fifties few people, except for a small band of enthusiasts, regarded it as a practical proposition except for short distances, such as between England and France and across St. George's Channel. The history of the Atlantic cable is too well known to need recalling here, but it undoubtedly provided the experience which made the laying of the Eastern Company's and all other long-distance submarine cables possible. To the engineers and others responsible for the actual laying of these early cables civilisation owes a very large debt of gratitude.

Atlantic Records.

ON her voyage which ended at Southampton on Saturday morning, the Olympic succeeded in wresting from the Mauretania her record for the fastest speed of an Atlantic liner. Compared with the 27.51 knots recorded for the Mauretania about two months ago, the Olympic during the later stages of her recent voyage maintained an average speed of 27.82 knots. The Cunard liner, however, still holds the record for the whole voyage, namely, an average speed of 26.06 knots made in 1910. On her three last crossings the Muretania's times to Cherbourg have been remarkably uniform, being progressively 5 days 8 h. 14 min., 5 days 8 h. 11 min., and 5 days 8 h. 9 min. These times indicate an average speed of about 25.28 knots. Subsequent to her arrival at Southampton the Olympic was dry-docked. It was then found that her sternpost was fractured. As a consequence, all her August sailings have been cancelled.

The Basle-Strasbourg Canal.

ANSWERING a question in Parliament, the President of the Board of Trade stated that the construction of the lateral canal to the Rhine from Basle to Strasbourg had not yet been begun. The Central Commission for the Rhine recently approved the plans for the first section. On this Commission Great Britain is represented by Mr. J. G. Baldwin, who has the right to record the two votes to which this country is entitled. Sir Joseph Broodbank, the late general manager of the Port of London Authority, has been appointed to act as the British Commercial Adviser to the Rhine Commission on questions relating to the improvement of the river.

The County of London Electric Supply Company.

THE County of London Electric Supply Company, Limited, was registered in 1891 for the purpose of supplying electricity in London and elsewhere. It started operations in 1895, and has since grown to be the largest electric supply undertaking in the administrative county of London. Its areas of supply now cover over 200 square miles. They are largely of an industrial character, and, in addition, support a resident population of about 1,500,000. Before the war it was realised that it was necessary to supplement the existing power station plant by the provision of a new capital station on a riverside site. For this purpose suitable ground with an area of about 91 acres was purchased at Barking, but further developments were stopped by the war. It has now been found possible to proceed with the scheme, and to enable the work to be financed the company recently invited subscriptions of additional capital in the form of 500,000 6 per cent. cumulative preference shares of £1 each at par and a like number of ordinary shares of £1 each at £1 2s. 6d. per share. The subscription list was opened on Monday. At 11 a.m. on that day the list was closed, both categories of shares having been many times over-subscribed.

Conditions in the Iron and Steel Trade.

IN his annual report Mr. McKenna, the general secretary to the National Union of Blast-furnacemen, records that the average weekly wage in the iron and steel industry fell from £5 7s. 11d. in September, 1920, to £3 8s. 2d. in October, 1921, and that of the men engaged at blast-furnaces at the end of 1920, 60 per cent. are now out of work. Grievous as these figures are, he speaks with justifiable pride of the joint sacrifices made by employers and workers in the interests of the industry, the former by making drastic cuts in prices and the latter by accepting wage reductions with patience and fortitude. The iron and steel industry has certainly shown a magnificent example to the country of how to make adjustments to new conditions without the accompaniment of strife and strikes. "Capital and Labour," says Mr. McKenna, "have both realised the tremendous difficulties of the transition, and the men knowing that business is being conducted at a loss have not only loyally accepted the reductions involved in the sliding-scale system, but have also, in some districts, agreed to accept further reductions in anticipation of the sliding scale in the hope of improving employment in the industry."

The Progress of Civil Aviation.

THE half-yearly report of the Director of Civil Aviation, covering the period from October 1st, 1921, to March 31st, 1922, does not reveal any substantial progress in aerial transport so far as this country is concerned. The total number of flights between the United Kingdom and the Continent was 1100 and the total number of passengers carried 2511, or just over two passengers per flight on the average. British machines alone made 485 flights, and carried 1686 passengers, or on the average about 3.5 passengers per flight. It would thus appear that British machines are more popular with travellers than foreign, or that the foreign machines carry the bulk of the goods traffic. The corresponding numbers of passengers carried in the same period of the previous year were 2023 and 1418, so that the advance made has been on the average about three extra passengers per day. As regards goods traffic, there was a very material decrease, the value of the imports by air reaching £132,774 and of exports £92,583, as compared with £206,357 and £167,731 respectively for the previous corresponding half-year. For the first time the half-year's flying was without fatal accident. In this matter, however, the record for the current six months' flying will show a considerable difference.

Shepherd's Bush Exhibition for Sale.

THE announcement is made that the whole of the Shepherd's Bush Exhibition estate, with all its buildings and other structures, is now being offered for sale by private treaty. The Exhibition was opened in 1908, and served its original purpose annually until the outbreak of the war, when it was taken over by the Government, at first for the housing of troops and afterwards for storing purposes and for the manufacture of tents, small airships and other munitions. The site extends to more than 100 acres and accommodates buildings having a total capacity of 35 million cubic feet. The present owners are now having all the buildings repaired and redecorated, and suggest that the purchasers might either put them to their original use, the holding of international exhibitions, or develop the site for building purposes or as a self-contained manufacturing city.

Wireless Telegraphy at Sea.

IT would appear somewhat late in the day, if not quite futile, to question the value of wireless telegraphy as a means of saving life at sea. Yet in a communication to a contemporary we notice that Alfred Holt and Company, not only question its value, but suggest that it is a nostrum not worth its cost. The firm urges that safety at sea should be made the subject of a public inquiry by impartial persons, who should be asked to report, among other things, upon how far seafaring risks should be accepted rather than avoided by incurring expense and discomfort. The company asserts that since the start of its business in 1866 the number of persons who have lost their lives through shipwreck on steamers under its management—excluding loss caused by enemy action during the war—was only thirty-four, and that not one of these lives could have been saved had wireless telegraphy been available. The statement that in fifteen years wireless telegraphy has been instrumental in saving over 11,000 lives and the salvage of more than sixty British vessels requires, the firm holds, careful analysis in order to determine how many of these lives and ships would have been lost had wireless telegraphy not been available. Good ship construction, management and navigation, it is added, are the only methods of obtaining safety at sea which are economically justifiable. This indictment of wireless telegraphy clearly calls for answer in the interests of the travelling public.

A Historic Harbour to be Closed.

WORKMEN have now begun operations in connection with the filling in of the West Harbour, Greenock, acquired by Harland and Wolff for the purpose of extending their shipyard. This harbour is one of the oldest in Scotland. It was constructed in 1710 at a cost of £5555, and was regarded at the time as the greatest work of its kind in the country. The cost of construction was largely met by the Superior, Sir John Schaw, who advanced the sum of £5000 for the purpose, on condition that he should be repaid by a levy of 1s. 4d. on every sack of malt used within the burgh for the brewing of ale. It is on record that the debt was cleared off in thirty years.

The Navy and Air Attack.

THE Admiralty has issued a statement characterising as unauthorised and inaccurate the reports which have appeared regarding the torpedo aeroplane attack on the Atlantic Fleet off the Isle of Wight on July 7th in the presence of the King. The exercise, it is pointed out, was not novel, and was designed as a spectacle rather than as a critical experiment. On a prearranged day at an hour signalled in advance the Fleet approached the aircraft base at slow speed in broad daylight. It offered an unresisting target, and in all respects the aerial attack was carried out under essentially unwarlike and unreal conditions. Even so, the hits obtained on the battle line were small in number and of minor tactical importance.

The Engineers' Ballot.

IT will be recalled that scarcely had the recent lock-out in the engineering industry resulting from the dispute concerning managerial functions been settled, when the possibility of fresh trouble was introduced by the proposal of the employers to reduce the war bonus paid to the men by a total of 16s. 6d. per week in three instalments. The unions concerned referred the matter to their members for their votes. The result of the ballot was announced on Wednesday evening, and showed a majority of 26,963 against the terms, 43,937 votes being cast in favour of acceptance and 70,900 otherwise. Taking the aggregate number of workers in the engineering industry at 900,000, it is significant that the total vote represents only about 12½ per cent. of those affected by the proposed reduction, while the effective part of the majority vote represents only 3 per cent. The representatives of the unions met the Engineering Employers' Federation yesterday—Thursday—afternoon to discuss the situation in the light of the ballot returns.

The Engineering Standards Association.

THE excellence and value of the work done in the past by the British Engineering Standards Association is recognised and admitted all over the world and should encourage those who support it with their time or their money to continue to do so, in spite of the difficulties through which the industry is passing at the present moment. During the past year nearly two thousand engineers gave the Association the benefit of their experience on committees and otherwise. The Association in that period issued seventy-two new or revised specifications, and sold 39,000 copies of its publications, in addition to a very large number of aircraft specifications which it distributed on behalf of the Air Ministry. The expenditure amounted to £17,000, towards which contributions amounting to £9300 were received from industrial sources, the balance coming from the Government, the India Office and the Governments of the Overseas Dominions. An earnest appeal is being made to those benefiting by the Association's work—and particularly to the many firms which do not at present contribute to its support—to assist it to build up a small reserve fund in order that it may not have to work from hand to mouth as it has been doing in the past.

An Extra-high Head Hydro-electric Plant.

OUR contemporary, *Le Génie Civil*, recently published an interesting account of the hydro-electric generating station which has been lately put to work at Fully in the Rhone Valley, Switzerland. The plant is specially noteworthy by reason of the fact that it operates under by far the highest head of water of any in the world. The actual head is 1650.7 m., or, say, 5416ft., and the pressure per square inch due to it is considerably in excess of a ton. The installation was carried out to the designs and under the supervision of the celebrated Swiss hydraulic engineer, Monsieur A. Boucher, who was responsible, among other high-head plants, for that at Vouvry, also in the Rhone Valley, where the available head is between 900 m. and 1000 m., and which we described in our issue of November 28th, 1902. The Fully station was built by La Société d'Electro-Chimie, which in 1909 constructed, also to Monsieur Boucher's designs, the hydro-electric station at Martigny, which utilises the waters of the Dranse under a net head of 175 m. and generates a maximum of 16,000 horse-power.

The Fully station derives its water supply from the Lac de Fully and the Lac de Sorniot. The highest water level reached by the former is 2145 m., or an altitude of, say, 7038ft. above sea level. The lowest point of the pipe line is at an altitude of 494.3 m.—say, 1622ft. The Lac de Sorniot stands lower, at about an altitude of 1990 m., or, say 6529ft. It is therefore just over 500ft. below the Lac de Fully, and the somewhat curious expedient of pumping its water into the pipe line at a pressure sufficient to raise it into the upper lake has been resorted to. In this way the water of the lower lake is made available without the necessity of having a separate pipe line and separate generating machinery, but there is, of course, a loss of power, though the loss is, apparently, regarded as of small importance having regard to the fact that the additional volume of water is made available without the cost of the additional pipe line and plant.

A plan and profile of the pipe line, &c., are shown in Fig. 1. The arrangements are such that it is possible to draw down the level of the Lac de Fully to the extent of 18 m.—say, 59ft.—which means an available storage capacity of about 3,200,000 cubic metres, or approximately 717,700,000 gallons. It is calculated that the quantity of water continuously available for power purposes is 800 litres per second. The estimated losses in the pipe line, &c., amount to about 10 per cent. of the total available head. On that basis 800 litres per second would provide continuously a potential energy of something over 15,000 horse-power at the turbines. As a matter of fact there are in the power-house four turbine sets—with room for a fifth—each turbine being designed to develop at its shaft 3000 metrical horse-power when supplied with 200 litres—say, 441 lb.—of water per second. The guaranteed efficiency of the turbine at a speed of 750 revolutions per minute varies from 81 per cent. at full load to 77 per cent. at half load.

The height of the barrage at the outlet end of the Lac de Fully is at present 12 m.—39.37ft.—above the original level of the lake, and its crest is at an altitude of 2139 m. It was originally intended to drive a horizontal tunnel into the bed of the lake for such a distance as would have permitted the level of the lake to be lowered through a vertical height of 35 m.—say, 114.8ft.—which would have given a reserve storage of 5,100,000 cubic metres—or, say, 1122 million gallons—representing just over seventy-three days' supply at 800 litres per second, supposing the lake received no drainage in the meanwhile. Actually, however, it was found that if such a course were pursued the tunnel would have come out beneath a considerable deposit of silt, so that the idea was abandoned and a vertical shaft, which was excavated from the bottom upwards, was adopted in its place. Consequently it is only possible, as has been said above, to lower the level of the lake through a height of 18 m.; but even so, the available storage represents rather over forty-six days' supply with nothing coming into the lake.

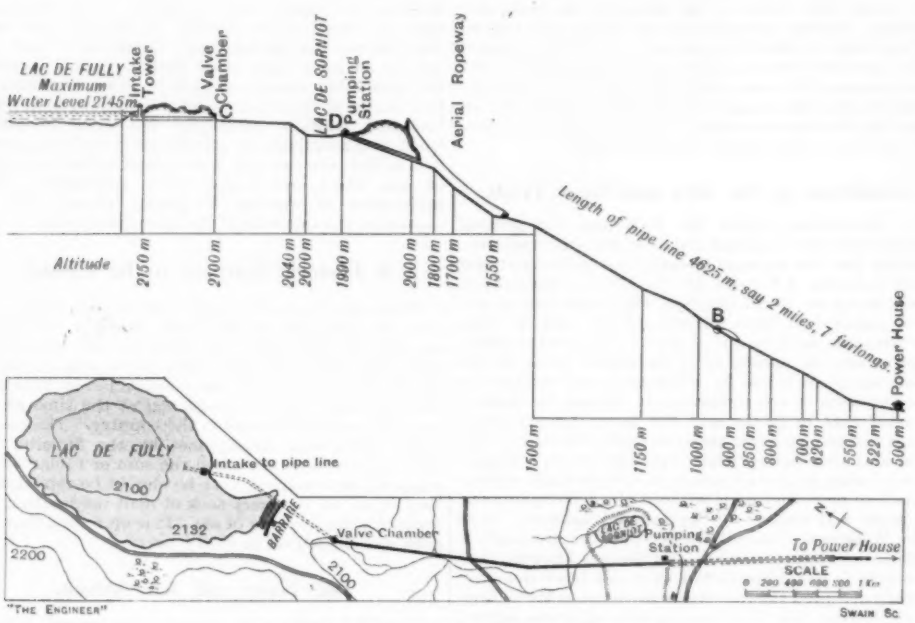


FIG. 1—PROFILE AND PLAN OF THE PIPE LINE

The form of inlet valve chosen for admitting water to the pipe line is shown in Fig. 2. It is contained in a circular perforated pipe, 2.6ft. in diameter, which reaches up to above the normal standing level of the lake. There is a snifting valve in the pipe line just below the valve, so that air may be expelled from or drawn into the pipe as required. It will be observed that the main inlet valve is duplex and consists of a larger valve E—about 15¾in. diameter—and a smaller valve H, which is about 6in. in diameter. Both valves are of cast steel. The larger has its seat on the steel casting G and the smaller is seated on the top of the larger. The valve H has attached to it four guiding wings or vanes F, which are about 4ft. 4in. long and which are arranged to slide inside the perforated pipe. The spindle of the valve H is prolonged downwards to receive a stop plate L, and upwards to above the tops of the vanes F, where it is furnished with a lifting ring. The object of having two valves is that the pipe line may not be filled with water too suddenly, the rupture of pipes having been experienced from that cause. Moreover, the force required to lift the larger valve against the full head of water would have been excessive. In filling the pipe line the smaller valve is lifted by means of a winch acting on a chain attached to the lifting ring, and it rises until the stop plate L abuts against a boss projecting from the underside of the valve E, which boss is furnished with ports having the same cross-sectional area as has the orifice leading to the valve H. The filling of the pipe line then proceeds slowly, the air ejected by the water escaping through the snifting valve. When the lake is at its highest level the pipe line can, it is said, be filled in about one hour. When it is full the large valve can, of course, be opened without effort, saving that required to lift its weight. The winch is operated by a worm and worm wheel. The valves just described are contained in a draw-off tower built at the side of the lake. From it there runs a pipe tunnel 6ft. 6in. high and 5ft. 3in. wide, and having a semi-circular roof, to the valve chamber at the head of the pipe line proper. A cross section of the tunnel and various sections of the valve chamber are shown in Fig. 4. In the latter there are two valves, one—the upper—an ordinary sluice valve fitted with a by-pass, the other an automatic valve which is intended to close should the pipe line be fractured or other mischance occur which would increase the rate of flow of water in the pipe line above a predetermined limit. The action of the automatic valve will be readily understood by the aid of the drawing in Fig. 3. The valve under normal conditions remains open and is held balanced above its seat by means of a counterweight on a pivoted lever. Should the rate of flow rise above the desired point the effect of the increased speed of water past the valve is to overbalance the counterweight and to close the valve on to its seat, the action being delayed by a dashpot, the liquid in which is petroleum. The valve chamber, which is on the side of the mountain, is well covered with soil, and the passage way leading to it is closed by two doors, one of wood and the other of iron, these precautions having been taken against frost, which is very severe, the altitude being nearly 7000ft. above sea level. The total length of the pipe line is 4625.5 m., or 15,176ft.—about 2 miles 7 furlongs. It is practically half and half 1ft. 11¾in. and 1ft. 7¾in. in diameter, the larger diameter, of course, being at the top. The pipes are of steel, those in the upper part of the line being welded, and those in the lower part being solid drawn. The maximum thickness of metal in the pipes at the bottom is 41 mm.—just under 1⅝in. The joints throughout are made in the manner shown in Fig. 5. A rubber ring made of round material 10 mm. in diameter is squeezed into a groove by the action of the tightening bolts. The laying of the pipe line was carried on from two points, *i.e.*, from the bottom upwards and upwards from the point B in Fig. 1, at which place the junction pipe was made telescopic so as to be adjustable—see Fig. 6. The pipe line is buried for the whole of its length and is only anchored in two places, one being at the point B.

The pumping station for forcing the water from Lake Sorniot into the pipe line is situated at the point D, Fig. 1. It contains an electrically driven multi-stage centrifugal pump which is designed to deliver 200 litres of water per second against a head of 154 m.—roughly, in British measures, 2645 gallons—of water per minute against a head of 505ft., or rather over 400 horse-power, not counting losses. The motor driving the pump is of the three-phase 50-period type and of 600 horse-power. It works at 750 volts.

The turbines are of the Pelton wheel type, their diameter to the effective centre of the buckets—of which there are fifty-four—being 3.55 m., say, 11.65ft., and they are designed to run at a normal speed of 500 revolutions per minute. The turbine disc, which is of forged steel, weighs 7 metric tons,

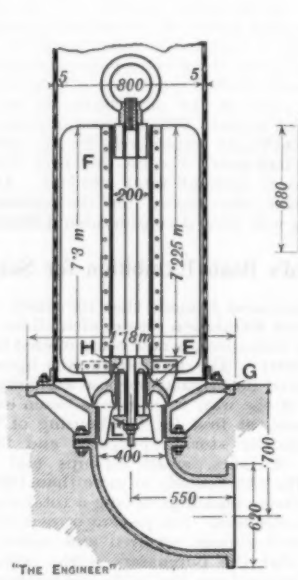


FIG. 2—MAIN INLET VALVE

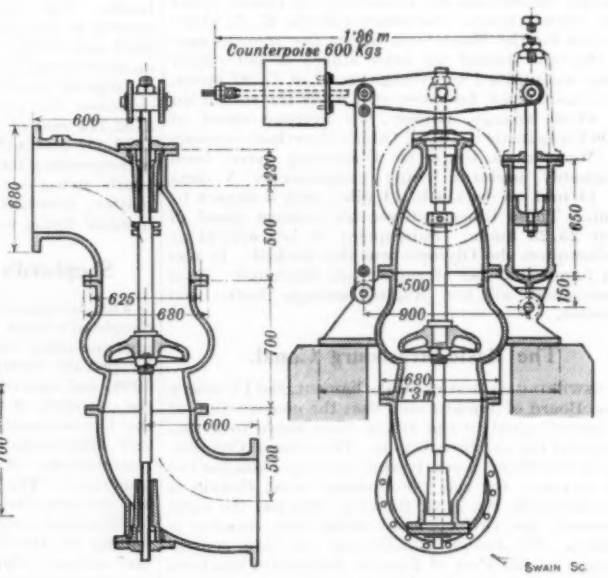


FIG 3.—AUTOMATIC SAFETY STOP VALVE

and the buckets, which are also of forged steel, each weigh 11.4 kilos., or about 25¼ lb. The diameter of the water jet is 34 mm., or nearly 1⅜in. Governing is effected in two ways—by deflection and by the needle in the nozzle. The former acts fully in two seconds, but the nozzle cannot be entirely closed by the automatic gear in less than forty seconds. A view of the governing gear and a part section of one of the turbines is shown in Fig. 7, while Fig. 8 shows diagrammatically three positions of the control arrangements. In the uppermost diagram—No. I.—the turbine buckets are seen receiving the full force of the jet. In No. II. the jet has been completely diverted from the buckets though the nozzle remains fully open, while in No. III., not only is the jet deflected, but the nozzle is closed as well. The control is effected by means of a centrifugal governor and a servo-motor. The former is driven off the main shaft of the turbine by means of a subsidiary shaft and worm gear, and it revolves at 750 revolutions per minute. Control can also, in case of emergency, be effected by hand by means of a hand wheel.

The valve which is used to admit the pressure water from the pipe line to the distributing pipe, from which the various turbines are led by branches, is constructed as shown in the section given in Fig. 9. The obturator, or valve proper, is a steel cylinder F, which is furnished with a bronze sleeve and is designed to slide on a fixed hollow rod L, and to work into and out of a bucket G, to the bottom of which the rod L is attached. The top of the bucket is furnished with six openings arranged radially at equal distances round its circumference as shown in the cross section on the line A B. The top of the obturator F is securely connected to the tube H, which is made to fit and slide on the hollow rod L. The upper end of the tube H is rigidly attached to a cylinder J which contains two coiled springs N_1 and N_2, the compression of which can be adjusted by means of the milled screw cap Q. Fixed unmovably on the fixed rod L is a piston K on which the cylinder J can slide. In the side of the rod L there is an aperture M which communicates with the hole in the rod and with the space below the piston K. When water under pressure is allowed to enter the hollow rod it finds its way through the aperture M into this space, and, since the piston K is fixed, the cylinder J and with it, of course, the tube H and the obturator F, are forced downwards against the action of the springs N_1 and N_2, and the valve admitting water to the distributing pipe is opened.

The hollow rod L has at its lower extremity a series of forty small diaphragms, which are so arranged as to form a labyrinth packing which throttles and controls the passage of the pressure water. It is through this labyrinth that the pressure water for actuating the valve makes its way. The upper end of L is connected by tubing to a controlling apparatus which consists of an orifice, the opening or closing of which can be effected either automatically or by hand. When it is closed pressure is set up below the piston K and the valve opens, the speed of opening being governed by the rate at which the water can make its way through the labyrinth packing. If, on the other hand, the orifice is opened, the pressure under the piston K is relieved and the valve is closed under the action of the springs N_1 and N_2, the rate of closing depending on the size of aperture given to the orifice.

It will be understood that, unless the distributing pipe is full of water so that there is pressure water above and below the valve, the latter cannot be opened, because unless there is pressure no water can find its way past the labyrinth packing at the bottom of the rod L and into the cylinder J. This means that the distributing pipe must itself be full of water, a state of affairs which is provided for by means of the by-pass R.

The electrical equipment in the main power-house does not call for much comment. The four three-phase, 50-period alternators, which run at the same speed as the turbines—500 revolutions per minute—are designed to absorb 3000 metrical horse-power with

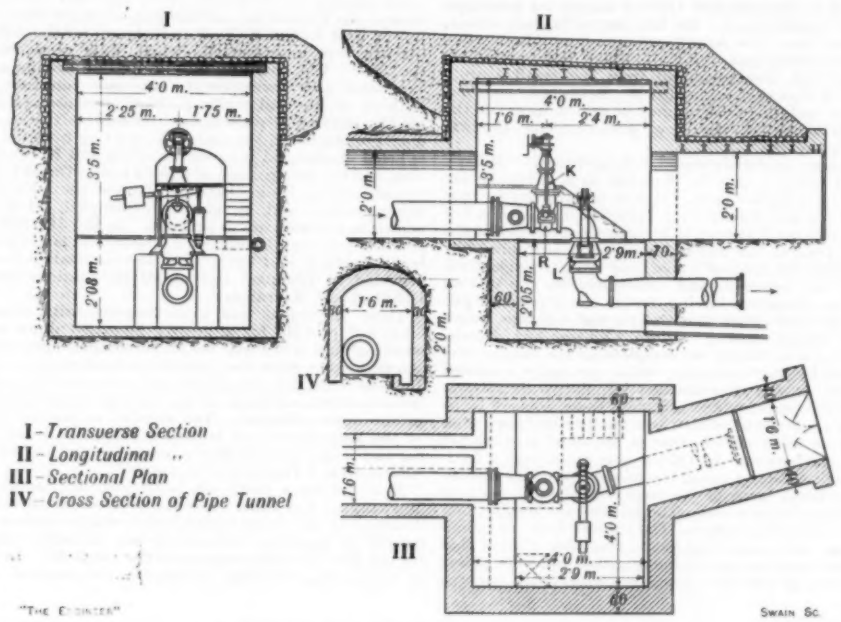


FIG. 4—SECTIONS OF VALVE CHAMBER AND PIPE TUNNEL

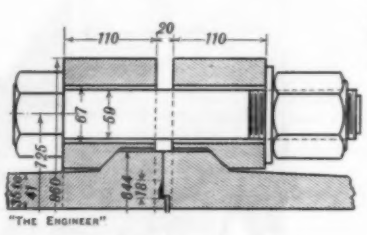


FIG. 5—JOINT IN PIPE LINE

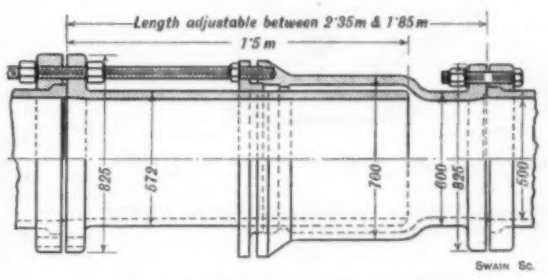


FIG. 6—TELESCOPIC JUNCTION PIPE

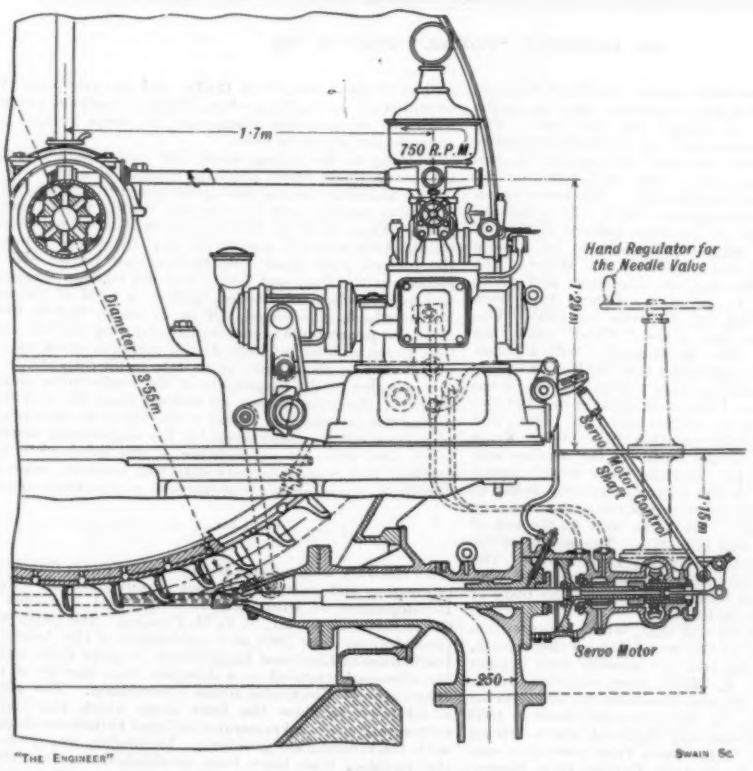


FIG. 7—PART SECTION OF TURBINE AND NOZZLE SHOWING GOVERNING GEAR

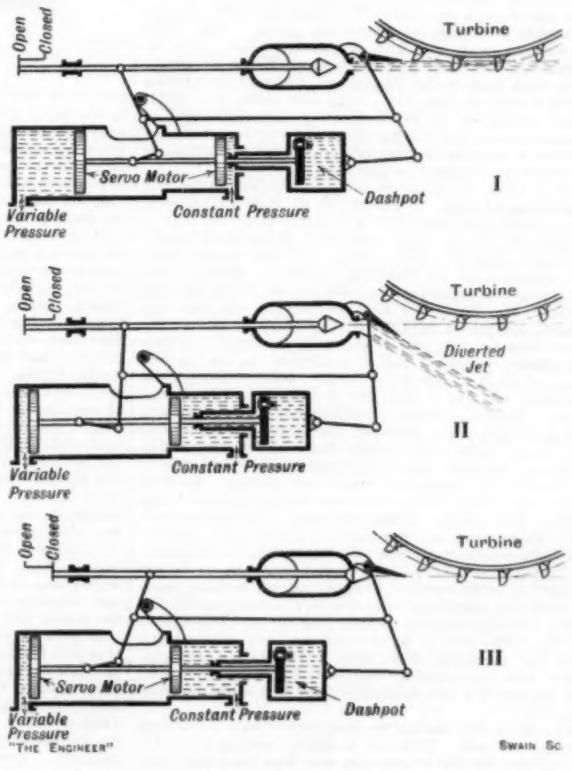


FIG. 8—DIAGRAMS ILLUSTRATING GOVERNING ARRANGEMENTS

a power factor of cos $\phi = 0.75$. They generate current at 10,000 volts, at which pressure energy is supplied to two of the transmission lines. For the line linking together the Fully and Vouvry stations, however, the voltage is raised to 25,000.

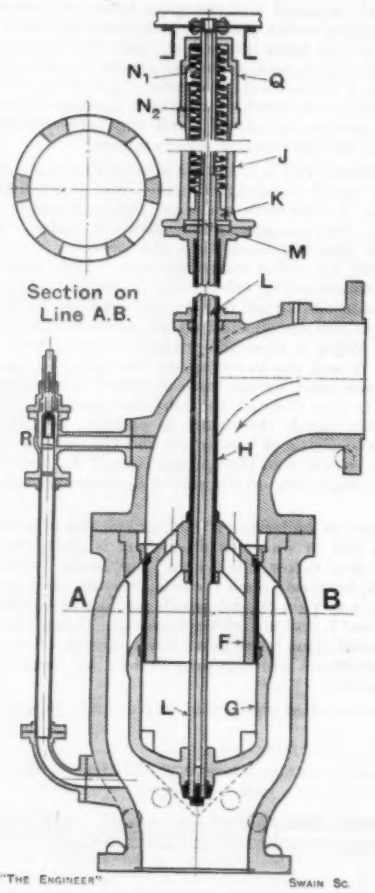


FIG. 9—VALVE FOR ADMITTING WATER TO TURBINE

An Interesting Link in the History of the American Locomotive.

By F. W. BREWER, A.I.L.E.

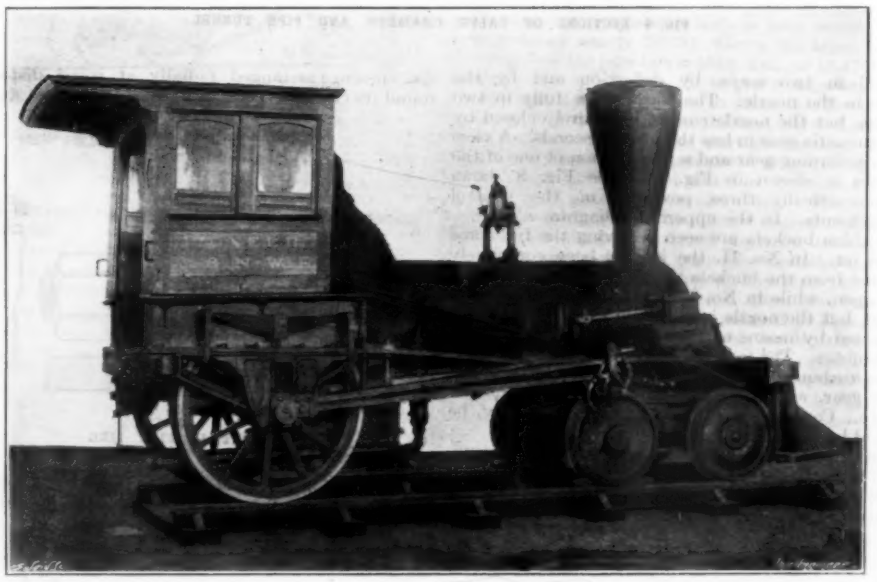
AMONG the original locomotives preserved in the United States, the Chicago and North-Western Railroad's Pioneer indisputably occupies an important place. This little single-wheeler was the first locomotive ever seen in Chicago, some seventy odd years ago. Hence it appropriately took part in the Pageant of Progress Exhibition which was held in that city during the summer of 1921. By the courtesy of Mr. H. T. Bentley, superintendent of motive power and machinery of the above-named railway, the writer is enabled to illustrate this notable example of early American locomotive practice.

Built in 1836, the Pioneer, directly and indirectly, has an interesting history. It was Mr. M. W. Baldwin's thirty-seventh locomotive, and it is now noteworthy in that it represents one of the most successful of his early types. The Pioneer was virtually a replica of the second locomotive constructed by Baldwin, the E. L. Miller. The latter engine was turned out in 1834 for the South Carolina Railroad. Mr. Baldwin's first locomotive was the Old Ironsides, completed in 1832 to the order of the Philadelphia, Germantown and Norristown Railroad. It was by no means a failure, and it continued in use on one railway or another for over twenty years. During its initial trials a speed of from 28 to 30 miles an hour was attained. On the occasion of its first trip to Germantown with a passenger train, however, one of the driving wheels worked loose on its axle, causing the wheel to drop inside the rail, at the same time disarranging the valve gear so that it would not operate in backward motion. Another trouble arose owing to the valves of the feed pumps being defective, the pumps failing to supply the boiler with water. Everything was put right in a few days, and the engine afterwards ran some efficiency trips to Germantown, but it was held by the railroad company to be too light for the work required from it and not to have complied with the conditions of purchase; consequently, Mr. Baldwin had difficulty in getting paid for it. The agreed price was 4000 dols.; in the end he compromised the matter by accepting 3500 dols. Rightly or wrongly, Baldwin was considerably discouraged, and he went so far to express the determination that it was his first and last locomotive.

Fortunately, circumstances soon caused him to take up a different attitude. A Mr. E. L. Miller, seeking about for a locomotive for the Charleston and Hamburg Railroad, went to Philadelphia, and there inspected the Old Ironsides. Before coming to a decision, he and Baldwin examined a number of English engines, and, in particular, one then on the Mohawk and Hudson Railroad. This engine, built by Robert Stephenson and Co. in 1831, and originally of the 0–4–0 type, after being at work about a year, had had the front pair of wheels removed and replaced by a "Jervis" four-wheeled swivelling truck. As altered, this type served as a model for Baldwin's second locomotive, the E. L. Miller, in which, however, he introduced several improvements. It was a great success, and with certain differences in power and details, Baldwin adopted it as his standard type of engine for passenger service for several years. The late Angus Sinclair, in fact, in 1907 said that "the American locomotive of to-day was developed directly from the E. L. Miller, just as certainly as a huge oak tree grows up from the small acorn." Certain it is that that engine led Mr. Baldwin to continue in business, and, in a sense, it may be said to have laid the first foundations of the now world-famous Baldwin Locomotive Works.

The Pioneer, as already stated, belonged to the "Miller" class, and hence it may be regarded as a distinctly important link with the past. It was constructed in 1836 for the Utica and Schenectady Railroad, but after a few years' service on that line, it became the property of the Michigan Central, on which railway it was dubbed the Alert. Here the original valve gear with a single fixed excentric was removed, and substituted by the motion seen in the engraving, having double excentrics and gab hooks. In 1848, when the Galena and Chicago Union Railroad—known to-day as the Chicago and North-Western—was in course of completion, the engine was taken over by that company, which promptly re-named it Pioneer. It was thus the first locomotive owned and run by that company, and although there appears to be no precise record as to when it was finally withdrawn from service, it is fairly certain that it remained at work till well into the 'sixties. In 1855 it was fitted with a feed-water heater arranged round the inside pipe of the smoke-stack, the latter being of the huge conical form usual on wood-burning locomotives. The heater gave trouble, and seems to have been a failure. The Pioneer drew the G. and C.U.R. pay car for several years, probably after it had become too light for more arduous duties, and when it was finally taken off the road it was not broken up, but was preserved, and was eventually sent to the Field Museum in Chicago. The cab, bell and cow-catcher were no doubt added some time after the engine was first built. The bogie wheels, 2ft. 6in. in diameter, are not those originally fitted, as the rear pair bear the date 1862, and an inscription denoting that they were made and patented by "A. Whitney and Sons, Philadelphia." The lettering on the front pair cannot be deciphered, but it will be noticed that these wheels are not of the same pattern as that of the second pair. The bogie itself seems to be a more modern structure than that of the E. L. Miller. The driving wheels were 4ft. 6in. in diameter, and these wheels, again, appear to be of a different type from those previously described by Baldwin in 1835. Unlike most of his locomotives of the "Miller" class, the Pioneer had cylinders 11in. in diameter, with a piston stroke of 18in. The steam pressure was 100 lb. per square inch, and the safety valves, which were on the dome above the fire-box, were of the then usual spring balance kind. The wheel base of the engine was 12ft. 11½in., and that of the engine and tender together, 27ft. 11½in. From the centre of the bogie to the centre of the driving axle the distance was 11ft. 1½in., and the bogie wheel centres were 3ft. 8½in. apart. A low centre of gravity being in favour at that period, the centre line of the boiler was only 4ft. 5½in. above rail level. From the rails to the top of the chimney the height was 11ft. 2½in. The weight of the engine (light) was approximately 10¾ British tons. The tender ran on four wheels having a diameter of 2ft. 6in., and standing on a wheel base of 7ft. 2½in. The body of the tender was 11ft. 3in. in length.

It may be of interest to add that, with the exception that the fire-boxes were of the round topped description, and not of the Bury type, four (or possibly five) engines very similar to the E. L. Miller were supplied by R. Stephenson and Co. to different American railways during 1833 to 1835. Of these, the Davy Crocket, built in 1833 for the Saratoga and Schenectady Railroad, was a striking example. Two engines of the same type were also constructed in that year by another English firm, Messrs. Charles Tayleur and Co., for the Camden and Woodbury Division of the Pennsylvania Railroad. All of these engines had leading bogies, and a single pair of driving wheels. The latter were placed behind the fire-box; hence the connecting-rods worked on either side of it in practically the same manner as in Baldwin's E. L. Miller, Pioneer, &c.



THE LOCOMOTIVE "PIONEER," BUILT IN 1836

RAILWAY EXPANSION IN INDIA.

ACCORDING to an article which appeared in a recent issue of the *Englishman*, of Calcutta, steps are being taken by the East Indian Railway to make up for the delays in carrying out improvements which were occasioned by the war. The company has a regular programme of expansion and development, not only concerning the solution of the coal traffic problem, but also providing for the comfort of passengers. As regards the improvements of the track, the main line, starting from Calcutta, is being quadrupled between Burdwan and Khana Junction, and the laying down of a third line to Ondal is under consideration. From Ondal to Barakar the main line is being trebled, and, in places, quadrupled, while large additions to yards are in progress. In the Jherriah coal-field the line from Dhanbad to Phularitand is in course of being doubled, and extra yard accommodation is being provided at Dhanbad and at all the stations between Dhanbad and Katrasgarh.

These alterations and improvements, with others in view, will provide for a greatly increased down traffic, which in turn will make for an accelerated movement of empty wagons from the northern and western directions. To deal with this increase in the movement of wagons from the north and the west, large works will be undertaken in the upper districts. The number of passing sidings on the Moghalserai and Allahabad sections is being added to, and it is probable that portions of the line between Allahabad and Tundla will be doubled.

New and large yards are being provided at Gya and Moghalserai, and these improvements, combined with the doubling of the Grand Chord, which will be pushed on as rapidly as possible, will provide the necessary facilities for the flow of empty wagons to the coalfields. Involved in the above-mentioned schemes is the renewal of the girders of the Lower Sone Bridge and the provision of a second track on the Upper Sone Bridge—both engineering works of considerable magnitude, as these bridges are amongst the largest in India.

Turning to the rolling stock, our contemporary states that some thirty-seven powerful engines of modern type will be added to the line during the year 1923–24, and that a similar number will be provided during the following years. From 2000 to 3000 wagons will be added to the rolling stock annually during the next five years. During the present year some seventy-nine new bogies will be placed on the line, and fifty-seven old coaches scrapped and new coaches substituted, making a total of 136 new bogies, which, it is hoped, will be in use by March, 1923. A similar programme is contemplated during the following four years, so that by 1926–27 the coaching stock on the line should be thoroughly up to date in all respects.

Some idea of the magnitude of the works to be undertaken by the railway may be realised from the fact that during the present year works to the value of three crores of rupees will be undertaken by the engineering department, and that the expenditure of the locomotive and carriage and wagon departments will amount, approximately, to one crore and four crores of rupees respectively.

IN the July issue of the *Metropolitan-Vickers Gazette* an interesting and instructive paper is published on "Some Developments in Insulating Materials and Processes in Great Britain," by Mr. A. P. M. Fleming. The paper was presented on June 28th at a conference of the American Institution of Electrical Engineers at Niagara Falls, which Mr. Fleming attended as a delegate from Europe of the International Electro-technical Commission. The paper is intended to show the lines along which the manufacturers of electrical apparatus in Great Britain are dealing with their insulation problems. Particulars are given of the facilities that have been established for insulation research, and the more important developments in insulating materials and processes employed in the various classes of electrical apparatus are discussed, with special reference to thermal characteristics and considerations. The opinions of British electrical engineers upon certain aspects of temperature rating of machinery as affected by insulation are considered.

Railway Matters.

WE regret to hear from Rome of the death of Signor Carlo Crova, the Director-General of the Italian State Railways, and the acting President of the recent Rome International Railway Congress.

IT is of interest to know that the two platform lines in Euston that are used by the new electrical services are part of the original station, opened in July, 1837, when the London and Birmingham Railway was extended to London.

THE stoppage of railway traffic during the coal dispute of last year, and the consequent suspension of the railwaymen's guaranteed week, cost the National Union of Railwaymen £50,000 a week for unemployment pay for its members. During the year the union paid out £712,629 in unemployment pay.

ONE of the big railway works on which the Italian Government is engaged is a direct line between Rome and Naples, paralleling the sea coast and 133 miles in length instead of 155 miles. The second section of this line was opened on the 16th instant, and only the 53 miles between Formia and Naples remain to be brought into use.

THE projected Urola Railway between Zumaya and Zumarraga will be electrically equipped instead of steam operated. The system to be adopted will be direct current at 1500 volts, and the trains will be of a similar type to those on the Sebastian to the French frontier line. The estimated cost is one and a-half million pesetas more than for steam.

AT one time the Southern Belle was the only train in this country composed wholly of Pullman cars. Early this year the Thanet Limited of the South-Eastern and Chatham was introduced, and now, beginning on Sunday next, there is to be a Clacton Pullman on the Great Eastern. The first of these three trains runs daily; the other two on Sundays only.

THE Bill confirming the new agreement as to parcels post conveyed by rail referred to in this column on July 7th was read a second time in the House of Commons on the 21st. The Postmaster-General said that were the companies paid 55 per cent., as was the case originally, the cost would be £3,300,000 a year; at 40 per cent., as had been agreed, it was £2,400,000.

THE Great Western time-table for the summer months, known among railwaymen as the "Penny Book," in contrast to the working time-table, includes the services for the Cambrian and South Wales lines that have been incorporated and absorbed therein. A railway company's "working time-table" gives the timings of the freight trains and the passing times for most of the stations at which expresses do not call.

AS the result of satisfactory experiments, undertaken at the instance of the French Ministry of Public Works, it has been decided in the case of light trains to replace steam traction by petrol motors, whereby great economies are anticipated. A motor drawing a carriage weighing 6 tons has, it is declared, succeeded in attaining an average speed of 52 kiloms. per hour on the level. The experiments in question were carried out over a total distance of thirteen hundred kilometres.

THE Midland Railway Company has installed at Derby eighteen light signals instead of twenty-six semaphore signals. They are not, however, the daylight colour light signals of which so much has been heard during the last twelve months and which give a long-distance view in daylight. They are no more than lamps with a red and a green lens. When this station was re-signalled in 1881 two overbridges blocked the running view of some new signals provided to protect the new scissors crossings then put in, and repeating signals had to be provided in the "six foot." The view for enginemen, signalmen and platform staff was unsatisfactory, but has been improved by these light signals, which are placed over the platform next to the line to which they apply.

THE American papers just to hand show that the cause of the wreck of a Philadelphia and Reading express between Camden (Philadelphia) and Atlantic City late in the evening of July 2nd, was due to the signalman thinking the approaching train was a freight train for Cape May and setting the points accordingly. The usual speed of the expresses on this remarkably level and straight road is always 70 to 75 miles per hour at this point—Winslow Junction—and evidently the driver, who was killed, failed to notice that the signals were "set" for the branch. The train was thus derailed on the curve because of the unsuitable speed, and three passengers and four servants were killed. An American contemporary is afraid that this disaster may lead to the public agitating for reduced speed. Surely this is unlikely. Trains would be all day making some journeys had the speed to be such that an unexpected turn-out did not lead to derailment. The real moral in this case is automatic train control, which would have told the driver the junction was set for the branch.

A WELL-KNOWN Manchester merchant has been writing to *The Times* and the *Manchester Guardian* complaining of a deterioration in the service by the London and North-Western and Midland routes between London and Manchester. An officer of the former company, seen on the subject, said that the longer time given is due to an increased number of intermediate stops in order to give better facilities for business centres in the Midlands. The latter statement is, to our mind, hardly correct. The 10.30 from Euston calls additionally at Crewe and takes 25 min. longer than before. The 12.10 is now 11.45, makes two calls as before, and takes 4 hours instead of 3 hours 40 min. The 2.40 now leaves 2.55, travels by the shorter route *vid* Stoke, calls there, and takes 17 min. longer. The 6.5 leaves at 6.30, makes the one call as before, and arrives at 10.30 instead of 9.35. It is the same on the up journey. There are, however, six down trains taking 4 hours and one with 4 hours 3 min., as compared with four with between 3 hours 30 min. and 3 hours 43 min., one with 4 hours 3 min., and one with 4 hours 15 min. The Midland had four down trains averaging 3 hours 50 min., and it has now four, all taking 4 hours. The true explanation for the longer journey is that there is no justification for such extravagant running.

Notes and Memoranda.

SOME riveted iron pipe, 44in. in diameter and ¼in. thick, which had been in service for thirty-one years, was recently relaid for sewerage purposes in Los Angeles. The pipe is said to have been in uniformly good condition.

CANADA'S registration of motor vehicles for 1921 shows an increase of more than 50,000 over the previous year, according to figures issued by the Highways Branch of the Department of Railways and Canals. Last year there were 463,848 motor vehicles registered in the Dominion, as against 415,268 the previous year.

DEMONSTRATIONS of a device for the production of "cold light," which were recently given before a group of international scientists by Mr. M. J. Ritterath, a Los Angeles inventor, have aroused great interest in the American cinema world. "Cold light" is claimed to be pure white and so free from heat that even highly inflammable films can be subjected to it for hours without fear of burning.

A SOLUTION of gaseous sulphur dioxide in acetone, or a mixture of liquefied sulphur dioxide and acetone, is recommended by H. Plauson as an extraction and absorption medium for organic substances. It is eminently suitable, it is stated, for the extraction of anthracite, brown coal, peat, &c., for the selective extraction of mixtures of solid or liquid hydrocarbons and other organic compounds, for the refining of oils, the separation of paraffin, ozokerite, &c.

A REPORT on the coal deposits in the Belgian Congo states that two deposits of coal had been discovered, both being in the Katanga district. One is situated on Lake Tanganyika, and the second on the Luena, near Bukama. Both deposits are geologically very analogous. At least five regular seams, of thicknesses varying between 2ft. 6in. to 5ft. 6in., are reckoned in the Tanganyika deposit, the total thickness reaching 16ft. As the total superficial area of the basin is estimated at 61,750 acres, it is calculated that the deposits represent over 1000 million tons of coal. The seams have but slight inclination, and are worked from the outcrop through adit levels. The Luena deposits cover an area of 494 acres, represent 16,000,000 tons, and the total thickness averages from 19ft. to 23ft.

COMMENTING on the meetings of the Institution of Electrical Engineers, the *Electrician* says that they are tending to become over stage managed. Care is quite rightly taken to provide speakers cognisant with the subject under discussion, but care is not always taken to give them time to develop their arguments. Neither has the heroic course of taking the paper as read yet been adopted, though it must come to that sooner or later. The Chairman might also control the meetings more closely than he does at present, shooting irrevelancy on the wing, and particularly exercising a censorship over congratulatory opening sentences. For the author knows the value of his paper. There is no need for speaker after speaker in the discussion to emphasise it. The two great needs at the moment seem, indeed, to be more time for discussion and a better use of the time provided.

IN concluding a paper on the fatigue of metals, read at the recent meeting of the American Society for Testing Materials, Professors Moore, Kommers and Jasper, of the University of Illinois, said that an interesting series of tests is now in progress. Specimens which have withstood 100,000,000 reversals of a stress close to the endurance limit have been subjected to further reversals at slightly higher stresses—in one case 16 per cent. higher—and they have withstood without failure a second run of 100,000,000 reversals of this increased stress. Static tension tests on other specimens which have withstood 100,000,000 reversals of stress close to the endurance limit have given distinctly higher values for tensile strength than those given by tension tests of the material before repeated stressing. These tests are by no means complete, but the possibility that steel may be actually benefited by repeated stressing below the endurance limit is of interest.

IN the course of his annual report, Dr. T. M. Legge, H.M. Senior Medical Inspector of Factories, points out that there is still a difficulty in making rescuers understand the importance of rest in the treatment of poisoning by carbon monoxide at blast-furnaces and on producer gas plants. The probable reason for walking men who have been gassed up and down is that the rescuers feel they are doing something, ignoring the state of shock into which the patient has fallen. One of the essentials in treating shock is to keep the patient warm, and treatment in the open air, if there is a room available, is inadvisable. In addition to the shock and lowered vitality of the patient, the damage done to the heart muscle itself by carbon monoxide gas is the principal reason why rest should be enjoined. Cases have been known in which sudden collapse and death have followed after the exertion of walking home, and were probably due to damage done to the heart itself.

IN a recent issue of the *American Manufacturers' Record* there is an account of the application of the electric furnace to the production of phosphoric acid. By this means a high-grade product is obtained, as the method lends itself readily to the elimination of the many impurities. The process consists of charging phosphate rock into an electric furnace with coke breeze to supply the carbon necessary for reduction purposes, silica rock to flux out the excess lime present in the phosphate rock, and iron turnings to form ferro-phosphorus. The production of the latter substance serves to remove the iron from the acid, a process which was always difficult under the old system. The phosphorus evolved burns to phosphorus pentoxide, which is carried over as a gas from the furnace. The vapour being hygroscopic when cooled to certain temperatures, a portion of the pentoxide condenses, and the remainder is collected by electric precipitators as a liquid. The phosphoric acid thus collected contains about 65 per cent. of phosphorus pentoxide. The use of phosphoric acid is mainly in the fertiliser industry, though it could be employed to fix ammonia from by-product gas, and so save the cost of sulphuric acid. Three electric furnaces of an aggregate capacity of 12,000 horse-power are now being operated by the Federal Phosphorus Company for the production on a commercial basis of ferro-phosphorus and high quality phosphoric acid.

Miscellanea.

THE Electricity Committee of the Glasgow Corporation recommends the purchase of a 2-ton Garrett electric demonstration vehicle, which the department has had on trial, at the price of £500.

WE hear that the Institution of Electrical Engineers has recently added the Technical College, Bradford, to the list of universities and colleges the diplomas of which are recognised by the Institution as exempting candidates from the associate membership examination of the Institution.

THE Polish Government has given to the Indo-European Telegraph Company a concession for that part of its line from London to Teheran which extends from Schneidemuehl on the west *vid* Thorn and Warsaw, to Rowno on the east. The Soviet Government has also promised the same company a concession for that part of its line extending from Rowno (Berdiohew) to Djulfa, on the Persian frontier.

DURING the recent congress in Bournemouth, of the Tramways and Light Railways Association, Mr. Richard Humphries showed a design of a car with a front-end exit on the near side, a completely vestibuled front, and with no bulkheads. To have the rear-end of the car cumbered with controllers and apparatus for the driver was, he said, very crude, and it was a distinct improvement to have the whole of that end given up to passenger service. It only necessitated a triangle at the terminus for reversing the cars, which could be laid generally without any additional Parliamentary authority.

BIRMINGHAM Corporation, which at present has a fleet of thirty-four electric vehicles for refuse collection, has made provision in its estimates for a further seven electric vehicles. These vehicles are used in the collection of refuse under the continuous system in those districts which are considerable distances from depôts, and which could only be worked on the continuous system by horses at greatly increased cost. Under this system the city is divided into small areas, to each of which a collection vehicle is allocated. The object of the system is to ensure that every house on a particular round shall be visited weekly so that all receive equal treatment.

DURING 1921 the number of accidents due to electricity was 322, of which twelve were fatal. These are reductions of 20 and 50 per cent. respectively compared with each of the two preceding years, and the improvement has no doubt been effected largely by a higher standard of electrical work. An analysis of the causes of these accidents was recently published, and from it it appears that several of them were due either to foolhardiness in working close to unprotected live conductors, or to attempts to carry out cleaning or repairs on live switchboards, while the renewal of fuses not constructed according to the regulations was another fruitful cause of trouble.

THE mechanical flax-pulling competition organised by the Société Centrale d'Agriculture de la Seine-Inférieure took place on July 18th at Vattetot-sous-Beaumont, near Bolbec. Three machines took part in the tests. The jury awarded 3000f. to the firm of Marshall and Sons, Limited, of Gainsborough; 3000f. to M. Zémont, a manufacturing engineer at Doullens, who entered a new type of puller with vertically drawing belts; and 3000f. to the Push-Tombyl pulling and binding machine, constructed at Sorrau and exhibited by the Russian engineer Schneider. Before leaving the field the members of the jury suggested various improvements which they considered might with advantage still be introduced in the machines.

WE are informed that during June a number of investigations of a varied character were carried out on behalf of the members of the British Cast Iron Research Association. Most of them are of general interest and importance, and provide valuable data in connection with the larger research works which are being carried out by the director. The research work in connection with draws and shrinkages, moulding sands and refractories, internal combustion engine cylinder castings and methods of testing cast iron are being pushed forward. A special committee has been appointed to carry out a thorough investigation in connection with malleable iron castings with the view of broadening out the use of this class of casting.

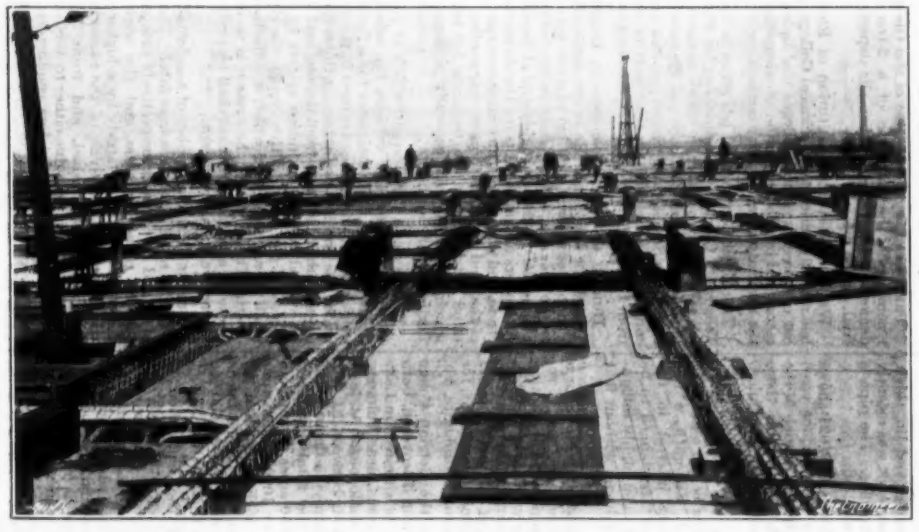
LEGISLATION has been inaugurated in Germany for four large water-power schemes, which will together involve the expenditure of 510,477,300 marks. The first law sanctions a grant of 311,000,000 marks for the development of water power of the lower Fulda—a new scheme. The second law sanctions additional grants for the further development of the water power of the river Main. The sums originally granted were 6,200,000 marks in 1916, and 25,573,000 in 1920. The further sum now granted is 44,272,000 marks. The third law sanctions further grants for the development of water power of the sources of the Weser. The sums already sanctioned are 10,500,000 marks in 1913, and 30,500,000 in 1920. The further grant sanctioned is 55,205,300 marks. The fourth law sanctions a grant of 100,000,000 marks for the purpose of ensuring the supply of water in the areas of the sources of the Weser and the Main.

ACCORDING to a Government report on the economic situation of Denmark during the year March, 1921–1922, numerous plans were under discussion throughout the year for the electrification of the country, either by the transmission of power from Norway and Sweden, or the exploitation of Denmark's own somewhat limited water-power, or by a combination of both schemes. With the falling cost of coal, however, it appears to be considered that the realisation of these plans will not, at present, at any rate, be economically justified. Indeed, doubts are expressed as to whether some of the existing water-power stations will be able to pay their way. The future electrification of Denmark by current from the other two Scandinavian countries remains, however, the object of investigation by an Inter-Scandinavian Committee. The experiments for obtaining electrical energy by means of various types of windmills also continue, but until a cheap and satisfactory form of accumulator is found, the necessity for having some other source of power in reserve would seem likely to render the use of windmills uneconomic in practice.

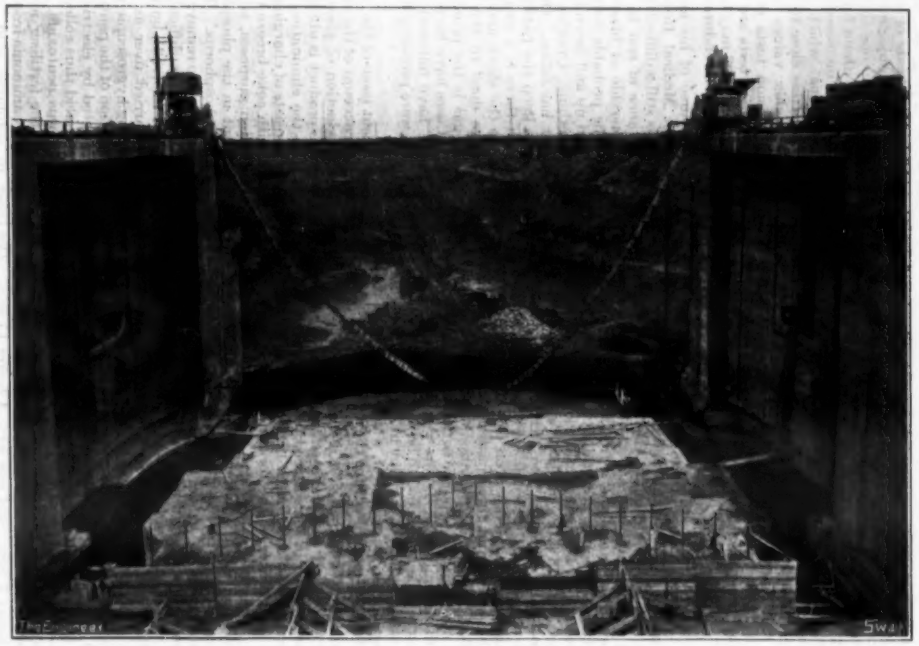
EXTENSIONS TO THE GLADSTONE DOCK AT LIVERPOOL

MR. T. M. NEWELL, M. INST. C.E. LIVERPOOL, ENGINEER

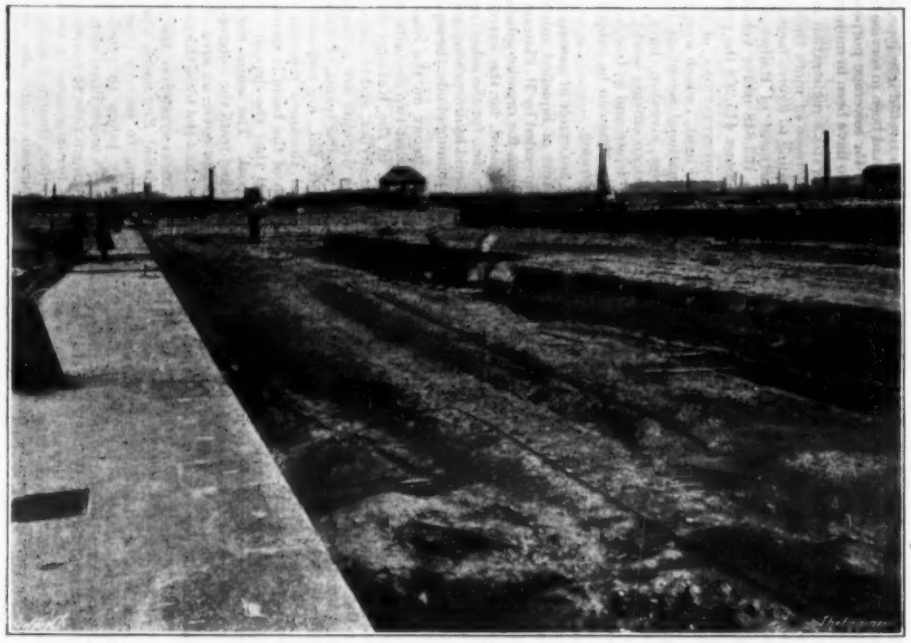
STEEL PILE COFFER-DAM FOR CONSTRUCTING OUTER WALLS



FIRST FLOOR OF TREBLE STOREY SHED



RIVER ENTRANCE LOCK—EXCAVATION FOR INVERT OF INNER GATE



NO. 1 BRANCH DOCK, LOOKING EAST

AGENTS ABROAD FOR THE SALE OF

The Engineer

BUENOS AIRES.—MITCHELL'S BOOK STORE, 576, Cangallo.
CHINA.—KELLY AND WALSH, Limited, Shanghai and Hong Kong.
EGYPT.—CAIRO EXPRESS AGENCY, near Shepheard's Hotel, Cairo.
FRANCE.—BOYVEAU AND CHEVILLET, Rue de la Banque, Paris; CHAPELOT AND CIE., 136, Bld. St. Germain, Paris.
BELGIUM.—W. H. SMITH AND SON, 78/80, Rue du Marché-aux-Herbes, Bruxelles, and 44, Rue Joseph II., Ostend.
INDIA.—A. I. COMBRIDGE AND CO., Bombay; THACKER AND CO., Limited, Bombay; THACKER, SPINK AND CO., Calcutta.
ITALY.—MAGLIONI AND STRINI, 307, Corso, Rome; FRATELLI TREVES, Corso Umbarto 1, 174, Rome; FRATELLI BOCCA, Rome; ULRICO HOEPLI, Milan.
JAPAN.—MARUZEN CO., Tokyo and Yokohama.
AFRICA—WM. DAWSON AND SONS, Limited, 7, Sea-street, (Box 49), Capetown.
C. JUTA AND CO., Johannesburg, East London, and Grahamstown.
AUSTRALIA.—GORDON AND GOTCH, Limited, Melbourne, Sydney, Brisbane, and Perth, &c.
MELVILLE AND MULLEN, Melbourne.
ATKINSON AND CO., Gresham-street, Adelaide.
CANADA.—DAWSON, WM., AND SONS, Limited, 87, Queen-street East, Toronto.
GORDON AND GOTCH, Limited, 132, Bay-street, Toronto.
MONTREAL NEWS CO., 386-388, St. James-street, Montreal.
TORONTO NEWS CO., 42, Yonge-street, Toronto.
CEYLON.—WIJAYARTNA AND CO., Colombo.
JAMAICA.—EDUCATIONAL SUPPLY CO., Kingston.
NEW ZEALAND.—GORDON AND GOTCH, Limited, Wellington and Christchurch; UPTON AND CO., Auckland; J. WILSON CRAIG AND CO., Napier.
STRAITS SETTLEMENTS.—KELLY AND WALSH, Limited, Singapore.
UNITED STATES OF AMERICA.—INTERNATIONAL NEWS CO., 83 and 85, Duane-street, New York; SUBSCRIPTION NEWS CO., Chicago.

Agents Abroad for Advertisements.

UNITED STATES OF AMERICA.—BRITISH AND COLONIAL PRESS, Inc., 736, The Knickerbocker Building, 152, West 42nd-street, New York City.
FRANCE.—AGENCE VOX, 7, Rue de Surène, Paris (VIIIe).
BELGIUM.—W. H. SMITH AND SON, 78/80, Rue du Marché-aux-Herbes, Bruxelles, and 44, Rue Joseph II., Ostend.

SOUTH AMERICAN BRANCH OFFICE OF

The Engineer.

536, Bolsa de Comercio, Buenos Aires.

SUBSCRIPTIONS.

THE ENGINEER can be had, by order, from any newsagent in town or country, at the various railway stations; or it can, if preferred, be supplied direct from this office.
Half-yearly (including index number) .. £1 12s. 6d.
Yearly (including two index numbers) .. £3 5s. 0d.
If credit occur, an extra charge of two shillings and sixpence per annum will be made.

Foreign Subscriptions will be received at the rates given below. Foreign subscribers paying in advance at these rates will receive THE ENGINEER weekly and post free. Subscriptions sent by Post Office Order must be made payable to THE ENGINEER and accompanied by letter of advice to the Publisher.

THIN PAPER COPIES.		THICK PAPER COPIES.	
Half-yearly ..	£1 11s. 6d.	Half-yearly	£1 13s. 9d.
Yearly	£3 3s. 0d.	Yearly	£3 7s. 6d.

(The difference to cover extra postage.)

Canadian Subscriptions—
Thin paper edition .. .. £2 18s. 6d. per annum.
Thick paper edition .. .. £3 3s. 0d. "

*** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at* 4s. 9d. *each,* 5s. 3d. *post free.*

ADVERTISEMENTS.

*** The charge for Situations Open and Wanted Advertisements of four lines and under is four shillings, and one shilling per line for each additional line up to one inch. When an advertisement measures an inch or more the charge is twelve shillings per inch. The rates for all other classes of advertisements, other than those mentioned above, are included in "THE ENGINEER Directory," which is sent post free on application. All single advertisements from the country must be accompanied by a remittance in payment. Alternate advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.

Small Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication). ALTERATIONS to STANDING ADVERTISEMENTS must arrive not later than THURSDAY of the week preceding publication.

Letters relating to Advertisements and the Publishing Department of the Paper are to be addressed to the Manager, all other letters to be addressed to the Editor of THE ENGINEER.

Postal Address, 33, Norfolk-street, Strand, W.C. 2.
Teleg. Address, "Engineer Newspaper, Estrand, London."
Telephone Nos. 2256, 2257 Central.

PUBLISHER'S NOTICES.

*** *With this week's number are issued as Supplements the Index to Vol. CXXXIII. and a Two-page Plate illustrating a Self-docking Floating Dock. Every number as issued by the Publisher contains copies of these Supplements, and Subscribers are requested to notify the fact should they not receive them.*

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

TO CORRESPONDENTS.

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

By arrangement with Reuter's Engineering Service, The Engineer contains the latest news from all parts of the world which is likely to be of interest to engineers.

Contents.

THE ENGINEER, July 28th, 1922. PAGE

ACCURATE END MEASUREMENT ON MEASURING MACHINES USING A SCREW. (Illus.) .. 81
DOCK EXTENSIONS AT LIVERPOOL. (Illus.) .. 83
FOTTINGER TRANSFORMERS ON A LINER.—No. II. (Illus.) .. 84
CONCRETE CYLINDRICAL BINS FOR COAL STORAGE .. 85
POSITION OF FRENCH RAILWAYS .. 85
THE NEW RULES OF LLOYD'S REGISTER OF SHIPPING .. 86
FRENCH COLONIAL PUBLIC WORKS.—No. I. .. 86
A SEVEN-DAY JOURNAL .. 87
AN EXTRA-HIGH HEAD HYDRO-ELECTRIC PLANT. (Illus.) .. 88
AN INTERESTING LINK IN THE HISTORY OF THE AMERICAN LOCOMOTIVE. (Illus.) .. 90
RAILWAY EXPANSION IN INDIA .. 90
RAILWAY MATTERS .. 91
NOTES AND MEMORANDA .. 91
MISCELLANEA .. 91
LEADING ARTICLES—
The Condensation of Steam .. 93
Electrical Accidents .. 93
THE STABILITY OF THE SAILING WARSHIP.—No. I. (Illus.) .. 94
LITERATURE .. 95
SHORT NOTICES .. 95
BOOKS RECEIVED .. 95
THE SELF-DOCKING OF A LARGE FLOATING DOCK. (Illus.) .. 96
IRON AND STEEL INSTITUTE .. 96
AN AMERICAN HIGHWAY SUSPENSION BRIDGE. (Illus.) .. 97
ANTIMONY IN CHINA .. 97
INDIAN ENGINEERING NOTES .. 98
AVOIDING DEFORMATION DURING MACHINING. (Illus.) .. 98
SINGAPORE ELECTRICAL SUPPLY .. 99
PROLONGATION OF LETTERS PATENT .. 100
MOTOR ROAD ROLLER. (Illus.) .. 100
A ROTARY EVAPORATIVE CONDENSER. (Illus.) .. 100
A LONG WELDED STEAM PIPE .. 100
PROVINCIAL LETTERS—
The Midlands and Staffordshire .. 101
Lancashire .. 101
Sheffield .. 102
North of England .. 102
Scotland .. 102
Wales and Adjoining Counties .. 103
LATEST NEWS FROM THE PROVINCES .. 103
LAUNCHES AND TRIAL TRIPS .. 103
PERSONAL AND BUSINESS ANNOUNCEMENTS .. 103
CURRENT PRICES FOR METALS AND FUELS .. 104
FRENCH ENGINEERING NOTES .. 105
BRITISH PATENT SPECIFICATIONS. (Illus.) .. 105
FORTHCOMING ENGAGEMENTS .. 106
CATALOGUES .. 106

TWO-PAGE SUPPLEMENT—SELF-DOCKING FLOATING DOCK; AND INDEX TO VOL. CXXXIII.

THE ENGINEER.

JULY 28, 1922.

The Condensation of Steam.

THE publication on another page of a brief description of the Ramsay condenser directs attention to the very few efforts that have been made to change the fundamental arrangements of the steam engine condenser. Many modifications in detail have taken place since Watt's famous experiments in Glasgow, but to all intents and purposes condensers remain what they were when he left them. They demand large quantities of water, and operate now, as they have since Watt's day, on the principle of causing steam to return to the form of water by abstracting heat from it. As long as steam engines were moderate in size, there was rarely any objection to this course. Water was a relatively cheap and plentiful commodity, and the power engineer suffered no anxiety as to supplies. But with the advance of electricity supply those easy conditions disappeared, until at the present moment we have reached the position where the site of power stations, of any magnitude, is controlled by the proximity of a copious source of circulating water. In stations of moderate size cooling ponds and cooling towers may meet the difficulty, or, at any rate, ameliorate it, but no one yet has ventured to suggest that a super-power station could be run economically unless it had command of a large river or was in close touch with the sea or some great lake.

In these circumstances it is rather to be wondered at that the condenser has been subjected to less research than any other part of the steam engine or steam turbine, and that the literature of it is proportionately scanty. For example, we take two standard works on the steam engine, those by Professor Dalby and Sir James Ewing. In the former we find a single chapter of a score of pages devoted to "The Cooling Circuit" as a whole, and in the latter the subject is dismissed in a few hundred words. From a rough search through our own volumes, we should estimate that specific references to condensers do not average more than three or four per year. We can only assume that this indifference is engendered by the belief that the whole matter is exhausted by the statement of the simple physical laws which control the exchange of heat, and that engineers have accepted, as beyond all further question, that thirty pounds of water, or thereabouts, must be provided for every pound of steam condensed in a surface condenser and twenty pounds in a jet condenser. The evaporative condenser, of which the Ramsay is a specialised type, is capable under favourable conditions of condensing pound for pound, but on account of the large area it requires it is never employed for great powers. Omitting, as we may safely do, the air-cooled condenser, these three represent types which have existed for many years with no changes more material than rearrangement of the tubes, compartmenting, and so on. In other respects, condensation remains, as we have said, just where it was a century and a-half ago. From time to time efforts have been made to reduce steam to water by other means, but they have met with little success and have been killed in infancy by ridicule or died a natural death. We recall one in which the condensing element was a mass of glass balls. The inventor claimed that condensation was brought about by the impact of the steam with these obstacles, and by its tortuous passage through the interstices; but although his trials satisfied him, they failed to satisfy others, and no more was heard of his condenser. It might, nevertheless, be still worth inquiring into the possibilities of the reduction of steam to water by mechanical means, but a more probable field presents itself in the triangular borderland that lies between engineering, chemistry and physics. It is not our intention to suggest new lines of investigation, but rather to stimulate imagination. Hitherto the only course pursued has been the withdrawal of heat units from the steam; the heat units have been abstracted by water and carried away to be dissipated in the air, in a river, sea or lake. We have, briefly, condensed steam by chilling it. A different course is physically conceivable. The familiar freezing mixture, ice and salt, provides us with a parallel. The temperature is reduced because the salt, through its affinity for water, induces a change of state, and that change of state is accompanied by a fall in temperature. Is it possible by some physical means—other than chilling—to induce a change of state in steam? The action of the ordinary driers—caustic soda or strong sulphuric acid—used by chemists is that of condensers. They reduce water vapour to solid water. Again, it is known that the introduction of dust with water will cause its precipitation, and it is probable that electrification would have a similar effect in certain circumstances. We mention these few phenomena to show that there is something—scanty indeed we admit—to work upon. But great results have sprung from lesser beginnings, and an exploratory investigation of *all* the lines of action that would present themselves to a physicist with a lively imagination might prove of benefit.

There are many obvious criticisms which can be levelled against these tenuous hints. They may be broadly divided into two classes—the economical and the practical. On the one hand, it might be said that any physical method of condensing steam—other than chilling—would in the long run be more costly than an abundant water supply; on the other hand, it might be held that the treatment would destroy the condensate as feed water if the equivalent of jet condensation were used. To these criticisms no reply is possible for the very simple reason that until we know what system we are going to employ no guess can be made as to its effects. Progress would cease if we were always hindered by speculating on the difficulties of application. The business of the researcher is to find out—in the first place—the facts and to leave the development of those facts or their discarding to the future. What we want to encourage now is the discovery of every way—other than mere chilling—of reducing steam to water. That is work for the physicist and chemist. After their share of the work is done, the engineer will take up the burden.

Electrical Accidents.

IN the annual report of the Chief Inspector of Factories, covering the year 1921, and issued during the early part of this month, Mr. G. Scott Ram, the Senior Inspector of Electrical Factories, gives some instructive notes on the generation and use of electricity. Although the quality of new work on factory premises continues to improve, there are, it seems, still examples of inferior work, and workmen and others are not completely free from danger. During the year under review there were 322 accidents attributable to electrical causes, twelve of them proving fatal. Compared with the two preceding years, these figures represent a considerable reduction, and would appear to indicate that electrical installation work has attained a high state of perfection, but it is, of course, to be remembered that the period with which Mr. Scott Ram deals was

one of great depression. Many works were partly shut down and the number of workpeople employed was considerably below normal. Moreover, whilst the reduction in the relative proportion of fatal cases is satisfactory, it can scarcely be regarded as a permanent improvement, because much depends upon the chance circumstances of the accidents. The reduction in the fatalities is entirely in respect of low-pressure shock cases, which only amounted to five, as compared with nineteen and twenty in the two preceding years. Incidental circumstances, however, such as duration of contact, the nature of the ground on which the victim happens to be standing, and whether efficient first-aid is promptly resorted to, have an important influence in determining whether such accidents have merely slight or fatal results.

On high-pressure and extra high-pressure systems there were twenty-one accidents, but only seven of them proved fatal. Seventeen of the accidents, including five which were fatal, occurred in public supply stations, and eight, including two fatal accidents, were met with by skilled persons. Four of the trained men who received high-pressure shocks owed their misfortune to foolhardiness in deliberately working in close proximity to live conductors, whilst five other accidents were attributable to unskilled men being permitted to work under such conditions. Accidents of this sort are, to say the least, very deplorable, and it is surely time that all operating engineers took proper steps to ensure that no unskilled person is allowed to work near live conductors, unless the job is carried out under conditions which make contact with such conductors impossible. Another cause of accident which has been very prevalent in the past, and which resulted in the death of four persons during the period which the report covers, is that of erroneously assuming that conductors have been isolated and made dead. It is perfectly obvious that all accidents of this kind can easily be avoided if those who are in charge of the work will test the condition of conductors before the job is begun. These tests can readily be made with the aid of suitable instruments which ought to be available in all power stations and other places where high pressures are in use. There is sometimes a tendency for experienced men to run risks, which are apt to involve loss of life, and it is only by framing and strictly enforcing rigid regulations governing the disconnection and testing of live conductors that absolute immunity from danger can be secured. From time to time various devices have been introduced for ascertaining whether high-pressure conductors are dead or alive, such, for example, as a vacuum tube at the end of a long rod, but the engineer of one of the large supply companies has introduced a device which appears to give exceptionally good results on systems working at pressures ranging between 3000 and 11,000 volts, and possibly more. Live conductors are indicated by a spark discharge instead of the usual glow in the vacuum tube, and, according to Mr. Scott Ram's report, the arrangement has proved extremely satisfactory wherever it has been tried. The main cause of accidents on high-pressure systems appears to be, however, that the necessity for testing conductors which are about to be worked upon is sometimes overlooked. The best of testing instruments are obviously of little value if they are only used occasionally or are put away and completely forgotten.

But a large proportion of the electrical accidents which are reported from year to year occur on low-pressure and medium-pressure circuits. During the year 1921 many of these accidents were due, as usual, to skilled and unskilled persons cleaning or repairing live switchboards or other apparatus. Portable apparatus and connections accounted for fifty-seven of these cases, whilst a number of accidents also occurred as the result of renewing fuses which were not constructed or protected in accordance with the regulations. There is no doubt that in spite of all improvements in design and workmanship and the rules that have been laid down governing the use of electrical apparatus, there is still room for ideas and restrictions which will promote safety. Considering the enormous increase in the applications of electricity and the great number of unskilled people who use it, the number of serious accidents which now occur is not alarming, but as electrical engineering is still rapidly progressing and careless workers cannot unfortunately be abolished, it is essential that efforts to secure maximum safety should not be relaxed. The appointment of four additional electrical inspectors will, it is to be hoped, result in the prevention of shoddy work, and the ultimate elimination of the incompetent and unscrupulous electrical contractor.

The Stability of the Sailing Warship

No. I.

By A. W. JOHNS, C.B.E., R.C.N.C., M.I.N.A.

DURING the last sixty years a large amount of information has been published on the subject of ship stability. Sir Edward Reed, in his book "The Stability of Ships," discusses in the most comprehensive way its theoretical development and methods of treatment and application. There is one period, however, upon which he does not touch, but which is probably more interesting than any before or after. This period extends from the beginning of the sixteenth to the middle of the nineteenth century, when the sailing warship was in process of evolution. In this type the possession of sufficient stability was of paramount importance, for without it she was useless for the purpose intended. Yet for the first two and a half centuries there was no theoretical information dealing with the matter, and naval constructors had to rely on a process of trial and error which often resulted in failure. During the remainder of the period, theoretical knowledge gradually accumulated, but in this country was not utilised as it should have been.

In 1746 Pierre Bouguer, member of the French Academy and Fellow of the Royal Society, published his "Traite du Navire," in which was first introduced the point named by him and still known as the *metacentre*. This point is now rightly regarded as one of the most important in a ship's geometry, for upon its position relative to and its distance from the centre of gravity of the ship, the stability at small angles of heel entirely depends. The importance of the point and the methods for determining its position are impressed upon the embryo naval architect almost at the outset of his instruction. Its position is the object of one of the first calculations made in the initial stages of a ship's design, and in the majority of vessels the beam is determined as a result. To those trained to the value of the metacentre, it will be a surprise to read that it was not until some 110 years after the publication of Bouguer's book that British naval architects realised its importance. Previously it had been considered as a point of some academic, but of no practical importance.

If this tardy recognition is a matter of surprise to the ordinary naval architect, it is inexplicable to those familiar with the early history of English warship development. They will remember that from the sixteenth to the nineteenth century complaints as to the stability of our warships were grave and persistent. The metacentre offered a simple solution of the problem, which was applicable to all types, and it might have been expected that it would have been welcomed and utilised. This, however, was not the case, and it was not until a later period—when, in fact, the wooden sailing ship was being replaced by iron steamships—that its value was recognised and admitted.

It is interesting and instructive to turn back some centuries and inquire into the types of vessels then existing, and to follow the developments during later times so far as they relate to the problem of stability.

At the beginning of the eleventh century the more civilised and populous communities were settled on the northern shores of the Mediterranean, and a fairly extensive maritime commerce was carried on between them. Galleys—a development of the primitive canoe—were the vessels employed for the purpose. The galley had gradually increased in dimensions, and at this period was from 80ft. to 90ft. long, with a breadth of one-sixth to one-eighth the length. A poop and forecastle, and also an upper deck were fitted. The sides of the galley tumbled out above the waterline, so as to give space for the rowers, who sometimes numbered five or six to an oar. More than one tier of oars were fitted in the largest galleys intended for show or for war, and thus triremes and quadremes with three and four tiers of oars respectively were built. Experience had shown that the greater the number of rowers the higher the speed which could be obtained. Length was necessary to get as many oars in a tier as practicable, and freeboard to get the maximum number of tiers. The draught was generally small compared with the breadth. During the following two centuries little development, except in increasing dimensions, took place in the galley.

Until the introduction of the mariner's compass in the early part of the fourteenth century, navigation was carried out at night by observation of the stars and by day generally in sight of land. Cruises were usually made in the summer, the conditions then being most favourable to the navigation of such craft. With the more general adoption of the mariner's compass, voyages became more direct and were extended beyond the Mediterranean. It is probable also the dimensions of galleys increased to permit of the longer voyages. England and the northern countries were visited, and these nations became acquainted with the types and sizes of Mediterranean vessels and their methods of navigation. This knowledge was materially assisted by the Crusades, in which nearly all nations took part, a very large proportion of the Crusaders being transported to the Holy Land in ships of the southern nations.

There is little doubt the owners of galleys engaged in commerce soon realised that for the longer and probably more lucrative voyages the employment of oars was not economical. The rowers with their accommodation, provisions and water, required weight and space which might be far more profitably allocated to merchandise or in time of war to soldiers and munitions. The pay of the rowers and the cost of their provisions were also a matter of some importance which decreased the profits. Besides this the Atlantic, with its rougher waters, was not so suitable for rowing vessels as the Mediterranean. It was natural, therefore, that attention should be directed to the wind as a far more economical means of propulsion.

The galleys were fitted with one or two masts, each carrying a yard and a lateen sail. The latter was set when the wind was astern or nearly so, the rowers resting on their oars. Sailing with the wind abeam was not resorted to, since the galleys were not of such form, dimensions and stowage as to conduce to good stability. It is often stated that this branch of the art of sailing was not understood at the time, but it is far more probable it was tried, resulted in the loss of the galley, cargo and crew, and was carefully avoided afterwards. The question of stability was becoming an important one.

Bitter experience showed that if sails were to be more generally employed, a type of vessel different from the galley was necessary. The Venetians, then the leading shipbuilders, introduced the gallease to meet the difficulty. This type of vessel was of about the same length as the galley, but of considerably greater beam, and thus had improved stability. It

A GALLEON

A SPANISH GALLEASE

"THE ENGINEER" SWAIN SC

had three masts, each with a lateen sail. Rowers were still carried, but in far fewer numbers, and as an auxiliary rather than a primary means of propulsion.

Even before the gallease there appears to have was a type of sailing ship termed a *buss*, in which the breadth was greater than in the galley. The *buss*, however, was so heavy and cumbrous that its speed and manœuvring power were far inferior to those of the galley, and the latter was preferred. Richard I. used several *busses* for transporting horses and stores to the Holy Land. The *buss* developed into the *cog* of the fourteenth century, a type of ship used at the naval battles of Sluys (1340) and Espagnolo-sur-Mer (1350).

The gallease was the intermediate step between the galley and the galleon. The latter was developed by the Spanish and Portuguese for navigation in the Atlantic, and depended upon sails alone. The Mediterranean nations soon followed the Peninsula in adopting the pure sailing ship, but gave distinctive names to their designs. Thus we have the carack, the caravel, the caramuzel, and other names for the same type of vessel differing in details to suit local conditions and taste. With the introduction of a purely sailing vessel, its size soon began to increase as experience in its construction and navigation was obtained. With the galleon square sails also came into use.

The reduction in the number of rowers in the gallease as compared with the galley and their omission from the galleon led to an alteration in the transverse shape of vessels, the sides above the water plane being given a tumble-home instead of a tumble-out, as in galleys. This modification

in transverse shape reduced top-weights and assisted the increased beam in securing improved stability. Vessels now were known as round ships to distinguish them from galleys or long ships.

So far as England and the Northern nations are concerned, little information is available as to the types and sizes of vessels used in earlier times. At the time of the Roman invasion the English vessels had greater freeboard than those of the invaders, and this was doubtless found necessary for the rougher seas they had to navigate. Later, in King Alfred's time, the "Saxon Chronicle" states, galleys twice as long as those of the Danish invaders, deeper, nimbler, less liable to rolling, and with forty to sixty oars, were designed and built by the King, and led to the discomfiture of the Danes. Later still, William the Conqueror is stated to have employed 3000 ships with 60,000 men to invade Britain, and these craft, with an average of twenty men in each, were probably similar in size and type to the English vessels. They appear to have been big canoes, but relatively deeper and wider than their prototype. Galleys were built and used, but were generally much smaller than those in the Mediterranean. Large galleys were not popular, as they required a great number of rowers, whose work was long and arduous. Slaves captured in war or purchased were employed as rowers by the Southern nations, but these were not available in the Northern countries. The seas were not so suitable for large rowing vessels as the Mediterranean. It is probable the art of sailing with the wind abeam was far more advanced in northern latitudes than in southern. Passages between Dover and Calais were frequently and quickly made, and this would appear to show that sailing with the wind abeam was practised. Accounts of early naval actions between ships of the northern nations refer to tacking as if it were a very usual manœuvre.

In 1380 the Venetians introduced guns on shipboard. In galleys these were placed on the front of the forecastle and fired forward. In galleases and galleons they were mounted on the upper deck and forecastle and poop, firing over the heads of the rowers in the case of the gallease. Other nations soon followed, and the number of guns mounted in ships began to increase, and as experience was gained, special mountings for ship purposes were introduced in place of the land mountings first used. The Holigost, the largest English warship in the early part of the fifteenth century, carried six guns, whilst the Regent, of 600 tons, built in 1486, carried 180. These were fitted on the upper works, i.e., in the fore and after castles, on the upper deck, and on the mast tops. Those in the castles fired through ports in the side, which were rendered tolerably weather-tight when the guns were not in use. Many of the guns were small and mounted to fire fore and aft through slots in the bulkheads forming the ends of the castles. These guns were the "murtherers," used in case an enemy boarded, when the guns were concentrated on him to drive him back.

In 1501 gun ports between decks were introduced by a shipbuilder of Brest, and were quickly adopted by the other maritime nations.

The introduction of guns on shipboard made the question of stability of still greater importance, for it introduced heavier top-weights and rendered it necessary still further to increase the beam as compared with earlier warships, in which men-at-arms, with their shields, swords, bows and arrows and other weapons formed the offensive and defensive features.

The early part of the sixteenth century witnessed striking developments in the design and construction of warships. Sailing with the wind abeam was now an ordinary branch of navigation, and this practice, with the omission of the rowers, permitted the size of vessels to increase. The greater size of ships led to a greater number of masts and sails. The value of guns on shipboard was recognised, and it was also seen that the greater the number which could be mounted the greater was the power of the ship. Increase in number was facilitated by the introduction of gun ports. The fitting of the latter differentiated the warship from the merchantman. Previously the latter was easily converted into the former by the fitting of end erections or castles and the mounting of guns on and in them. Efficient conversion now became a more difficult matter. Special ships for war purposes became necessary to a nation which had to defend itself at sea.

The discovery of America in 1492, the voyage of Vasca de Gama to India in 1497, the visits of Portuguese navigators to the eastern and western shores of Africa, the rounding of Cape Horn and discovery of the East Indies by Magellan, all resulted in an increase in the size of ships. This was necessary for the longer voyages entailed and for the transport of the products of the newly found lands to Spain and Portugal. The great wealth which accrued to these two nations by their discoveries gave them the means to build larger ships both for purposes of war and commerce. Other maritime nations with more limited resources had to follow their example in the matter of size, but for a long period these two nations held the lead.

So far as the English navy was concerned, the sixteenth century was of paramount importance. Henry VIII., and possibly his predecessor Henry VII., realised the value of sea power to an island nation, and built and bought ships, forming the foundation of the future British navy. Henry VIII. extended and improved the Royal dockyards, brought over Italian workmen to instruct the *personnel* in shipbuilding, and gathered together a staff of technical experts to design, build, rebuild, refit and repair his warships. The records of ships and shipbuilding, which before his time are vague and untrustworthy, now begin to become clearer and more reliable.

The loss of Calais, our last stronghold on the Continent, in 1558, brought to a close the period during which the English fleet had been principally engaged in transporting and supporting troops and thrust upon it the more important duty of the first line of defence.

Literature.

Metallography. By CECIL H. DESCH. Third edition. Longmans, Green and Co., London. 1922. 16s. net.

THE science of "metallography" has grown so rapidly that it is a matter of difficulty for the author of any text-book to keep his work reasonably up to date, and for this reason, among others, the appearance of a new edition of Professor Desch's well-known book is heartily welcome. The extremely difficult task of selecting from the great mass of new work that which it is most important to incorporate into a comparatively elementary text-book has been faced with great care and conscientiousness. The author's encyclopædic knowledge of the literature of his subject is well known, and makes itself felt throughout this edition of his book. Such a text-book must necessarily be regarded as extremely valuable to the student of the subject, and if we find it necessary to offer some criticisms in detail it should be borne in mind that compensating faults are probably to be found in any book on this subject.

Accepting the standpoint that this is one of a series of text-books of "Physical Chemistry," it is not surprising to find that the greater part of the volume is devoted to the physical chemistry aspect of metallography. For students of metallurgy who have a grounding in physical chemistry, this partition is entirely suitable; but for students who approach the subject rather from the physical and engineering side, the treatment is much less satisfactory. The section dealing with the metallography of the iron-carbon system is, however, much improved in the present edition. But even now the treatment is not as complete as might be expected. Thus the high-temperature transformation of iron and its carbon alloys (the delta-gamma transformation) merely receives casual mention, and is not shown on the equilibrium diagram.

In a book so full of references to the work of other investigators it seems almost hypercritical to suggest that full justice has not always been done, but in some instances that appears to be the case. In spite of his evident effort to treat controversial matters in a spirit of unbiassed fairness, the author has been led by his own views unduly to ignore certain lines of research which have in recent years led to the contribution of important new knowledge. Thus the whole theory of the existence of an amorphous intercrystalline layer in unstrained metals and alloys, as developed mainly by workers at the National Physical Laboratory, receives only cursory mention, many of the important papers relating to it being left without reference. Similar remarks apply to a number of other important investigations carried out and appliances devised in the same laboratory. Even some recent investigations of ternary alloy systems and the models devised for illustrating them are omitted from the bibliography of such systems. Hence a series of unfortunate omissions which will have to be rectified at some later stage arises. Again, in quite another direction, Professor Desch appears to do scanty justice to the work of Bengough and his collaborators on corrosion. The author still adheres to the view that "dezincification" can and does occur in the corrosion of brass, and dismisses the convincing evidence of Bengough in somewhat cavalier fashion.

A book dealing with so great a subject in a small space cannot, however, avoid errors, particularly of omission, and those to which we have referred can easily be rectified by any teacher whose class of students uses Professor Desch's book. Only to those reading the subject for themselves need the advice be given that comparison with the views of others is eminently desirable.

SHORT NOTICES.

Garske and Fells Factory Accounts. By J. M. Fells. London: Crosby Lockwood and Son, 1922, 15s. net.—This is the seventh edition of the book, which has been in existence for nearly forty years, and has been considerably extended in the present instance, while some of the matter included in previous editions has been omitted. Thus the original chapter on the methods of remunerating labour has been left out on account, so the author says, of the present controversy on the subject. On the other hand, that part dealing with establishment charges has been elaborated. The book, which includes nearly 300 pages, is most comprehensive in its character and gives numerous examples of the manner in which the books of a factory should be kept in order that the condition of its affairs may be discovered readily and with exactitude.

Willing's Press Guide, 1922. London: James Willing, Limited, 30, King-street, Covent Garden, W.C. 2. Price 2s. 6d.—We have received a copy of the above-mentioned guide, which is now in its forty-ninth year. It has been throughly revised and brought up to date to the time of going to press. It includes, besides papers of the United Kingdom, a list of the principal colonial and foreign journals.

BOOKS RECEIVED.

Vacuum. By Henry A. Fleuss. Reading: Poynder and Son, Holybrook Press, Gun-street. Price 6d. net.

Railway Electric Traction. By F. W. Carter. London: Edward Arnold and Co., 41-43, Maddox-street, W. 1. Price 25s. net.

Practical Refrigeration for Marine Engineers. By H. E. Roberts. Glasgow: James Munro and Co., Limited. Price 4s. 6d. net.

Railway Claims Explained. By G. Fraas and M. Baldwin. Manchester: John Heywood, Limited, 121, Deansgate. Price 3s. 6d. net.

A Practical Treatise on the Metals Used in Marine Engineering. By W. H. Colpitts. Glasgow: James Munro and Co., Limited. Price 10s. 6d. net.

Encyclopédie Léauté: Les Progrès de la Métallurgie du Cuivre. Par Auguste Conduché. Paris: Masson et Cie. and Gauthier Villars et Cie. Prix 14f. net.

The All-electric Age. By Adam Gowans-Whyte. London: Constable and Co., Limited, 10, Orange-street, Leicester-square, W.C. 2. Price 7s. 6d. net.

Coal Tar Colours in the Decorative Industries. By A. Clarke. London: Constable and Co., Limited, 10, Orange-street, Leicester-square, W.C. 2. Price 6s. net.

War Record of the London and North-Western Railway, By E. A. Pratt. London: Selwyn and Blount, Limited. 21, York-buildings, Adelphi, W.C. 2. Price 1s. net.

Industrial Motor Control, Direct Current. By T. A. Dover. London: Sir Isaac Pitman and Sons, Limited, Parker-street, Kingsway, W.C. 2. Price 2s. 6d. net.

Income Tax, Excess Profits Duty, Super-tax and Corporation Profits Tax. By C. H. Tolley. London: Waterlow and Sons, Limited, London Wall, E.C. Price 6d. net.

Model Electric Locomotives and Railways: The Details of Construction. By Henry Greenly. London: Cassell and Co., Limited, La Belle Sauvage, E.C. 4. Price 6s. net.

Encyclopédie Léauté L'Azote: La Fixation de l'Azote Atmosphérique et son Avenir Industriel. Par Louis Hackspill. Paris: Masson et Cie. and Gauthier Villars et Cie. Prix 14f. net.

Metal Cutting Tools: Their Principles, Action and Construction. By A. L. De Leeuw. London: McGraw-Hill Publishing Company, Limited, 6 and 8, Bouverie-street, E.C. 4. Price 15s. net.

Catalysis, with Special Reference to Newer Theories of Chemical Action. A general discussion held by the Faraday Society. London: The Faraday Society, 10, Essex-street, Strand, W.C. 2. Price 9s. net.

Automatic Pumping and Notes on Water Analysis and Filtration. By W. Walker Fyfe. Edited by J. W. Fyfe. London: Charles Griffin and Co., Limited, Exeter-street, Strand, W.C. 2. Price 7s. 6d. net.

Wireless at Home: Everybody's Guide to Receiving Wireless News, Concerts and Messages. By H. de A. Donisthorpe, late Capt., R.E. London: Percival Marshall and Co., 66, Farringdon-street, E.C. 4. Price 6d. net.

Textiles. The Westminster Series of Books on the Useful Arts, Materials and Manufactures. By A. F. Barker, M.Sc. Revised edition. London: Constable and Co., Limited, 10, Orange-street, Leicester-square, W.C. Price 15s. net.

Department of Scientific and Industrial Research. Food Investigation Board, Special Report No. 10: *The Methods Used for the Inspection of Canned Foods.* By W. G. Savage. (Part II., Canned Marine Products.) London: His Majesty's Stationery Office, Imperial House, Kingsway, W.C. 2. Price 1s. 6d. net.

Railways and Railway Securities. A study of all the railway companies whose securities are quoted on the Stock Exchange, London, with details concerning capital and resources. By F. C. Betts. London: Mortimer, Harley and Co., Limited, Bank Buildings, St. James-street, S.W. 1. Price 25s. net.

Department of Scientific and Industrial Research. Food Investigation Board, Special Report No. 7: *The Preservation of Food by Freezing, with Special Reference to Fish and Meat: A Study in General Physiology.* By Walter Stiles, M.A., Sc.D. London: His Majesty's Stationery Office, Imperial House, Kingsway, W.C. 2. Price 10s. net.

The Department of Scientific and Industrial Research. Fuel Research Board, Special Report No. 4: *Tests on Ranges and Cooking Appliances.* By A. H. Barker. An abstract from the report of the Building Materials Research Committee. London: His Majesty's Stationery Office, Imperial House, Kingsway, W.C. 2. Price 2s. 6d. net.

British Engineering Standards Association: Publication No. 83, 1922. "British Standard of Reference for Aircraft Dope and Protective Covering (including Specifications for each Ingredient and Method of Application)" (revised April, 1922); Leaflet [2 T.9. May, 1922] (cancelling Admiralty Air Department Specification T.9.) "British Standard Specification for Aircraft Material: Aluminium Tubes;" Leaflet [M.15. May, 1922], "Notes on Conditions for the Storage of Seasoned Aircraft Timber Previous to Conversion;" Leaflet [M.18. May, 1922], "Notes on the Heat Treatment of Wrought Light Aluminium Alloy (Duralumin) for Aircraft Purposes;" Leaflet [M.19. May, 1922], "Notes on the Heat Treatment of Wrought Y Alloy for Aircraft Purposes."

The Self-docking of a Large Floating Dock.

THE floating dock which forms the subject of the present article has a lifting power of 14,000 tons and was built by the Netherland Shipbuilding Company, of Amsterdam, to the designs of Messrs. Clark and Standfield, Victoria-street, London. It reached East Indian waters in November, 1913, and after lying in the naval basin at Surabaya for over two years it was let to the Surabaya Dry Dock Company, in the service of which firm it has since dry-docked the largest steamers calling at Java ports. Having due regard to the heavy fouling properties of tropical waters, its original owners, the Dutch Government, intended that it should be dry-docked after a period of five years. In consequence, however, of circumstances arising from the European war the first important examination and repair could not be carried out until May, 1921. We are indebted to the Surabaya Dry Dock Company and Messrs. Clark and Standfield for an interesting report on the condition of the dock and for the illustrations showing the operations of docking which we give herewith and in our Supplement.

THE TYPE OF DOCK.

The dock is of the bolted sectional type and is made up of three sections, which under normal working conditions are connected together so as to form one continuous structure. For self-docking purposes they are uncoupled and their design is such that any two can, in turn, lift the third. Fig. 1 shows diagrammatically the method of lifting the end and centre sections respectively. From the illustrations given it will be noted that the two end sections of the dock have pointed ends which extend beyond the side walls, while the centre section is rectangular in shape. In order to lift the rectangular centre section the two others are sunk with their pointed ends turned together. These pointed ends are drawn beneath the centre section, and on pumping out the end sections they rise and lift the central section clear of the water, as shown in Fig. 2. When lifting an end section—see Supplement—its pointed end is pushed between the side walls of the rectangular middle section and its square end is lifted on the point of the other end section. The joint between the sections in the pontoon portion of the dock is made by means of bolts which connect together the angle bars running round the profile, the water-tightness of the joint being further ensured by the fitting of a rubber gasket. Up the side walls and across the top deck the joint is an ordinary butted joint with double butt covers. The design of the sectional joint is so arranged that when the sections are secured at the top of the upper walls the pressure of the water on the two sections may be used to close the pontoon rubber cushion joint, and after the compartments are pumped out the new joint can be made in the dry.

In the present instance the uncoupling of the sections was accomplished quite successfully without any accident or mishap, and it was found that when adrift the sections floated at approximately the same draught. They were then towed to a sheltered berth, at which the lifting and overhaul of the individual sections were carried out. During the lifting operation the valves were operated by hand, specially trained native dock hands being appointed for this purpose.

Each of the three sections was lifted in turn, the lifting operation taking from five to nine hours, depending on the circumstances. When lifted, each section was cleaned, scraped, and given a coating of bituminous enamel and then re-floated.

GENERAL CONDITIONS OF THE DOCK.

The under-water portions of the dock proved to be in very good condition, having regard to the period of eight years in which the dock had remained in tropical waters. The fouling was not excessive and consisted principally of seaweed, which could be easily removed. In none of the sections was it necessary to renew a single shell plate, for the bituminous enamel—Briggs' "Tenax"—had preserved the plates so well that they proved to be quite bright and sound after removing the protective coat, the plate seams in particular appearing as though they were new. It was found, however, that at various places on the dock deep pits had occurred. These pits were due apparently to a shellfish which adheres to the plating and secretes acid which gradually eats a hole right through the steel. They occured chiefly where the enamel coating had been damaged by abrasion. From 400 to 500 of these holes were found in each section, and they were repaired by welding electrically or by the oxygen-acetylene process. The number of pits decreased towards the middle of the dock and was greatest on the side walls.

The internal condition of the sections was found to be quite satisfactory. There was no pitting, and the coating of enamel had given perfect protection against oxidation.

After the removal of the old coating the plates were thoroughly brushed and a new coat of bituminous solution was applied, the conditions being such that after the lapse of one day this coat was sufficiently dry for the application of a coat of bituminous enamel. The work of cleaning and enamelling was carried out by native painters under the supervision of a representative of the manufacturers of the enamel.

The galvanised wrought iron piping was not found to be in such good condition; it had deteriorated at its lower surfaces, where apparently it had remained in contact with the residual water in the compartments; but the cast iron main drain was quite good. The lead pneumatic tubing of the valve lifting gear had to be overhauled, but it was not necessary to renew any of it. The pump motors and the electric plant in the power station, which are under constant supervision, were in good order and needed no attention. The electric wiring inside the side walls, in consequence of the damp and warm atmosphere, required renewal in places, particularly the low-tension wiring of the pneumatic valve control gear and the electric lighting installation.

The re-connection of the sections was successfully accomplished, and the dock has been put to work again, the complete repair having occupied a period of about four months.

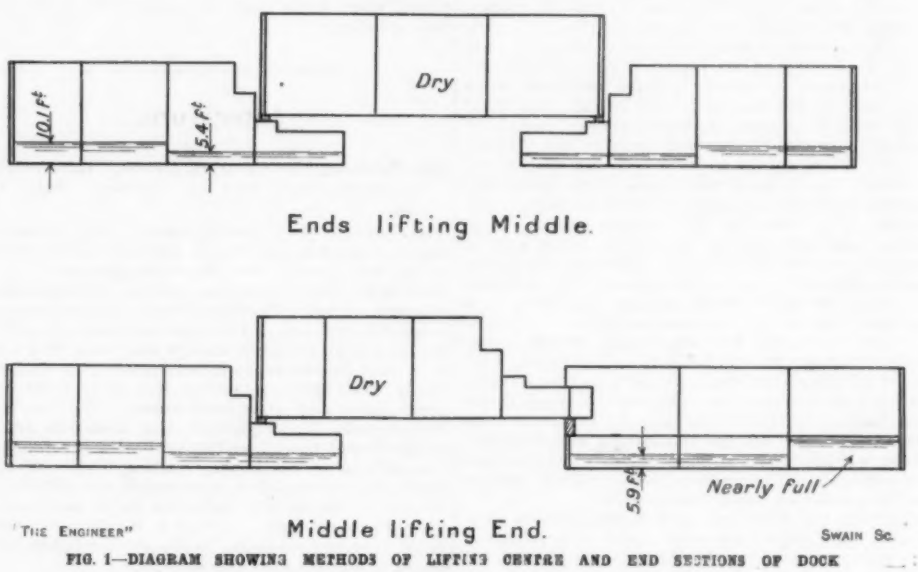


FIG. 1—DIAGRAM SHOWING METHODS OF LIFTING CENTRE AND END SECTIONS OF DOCK

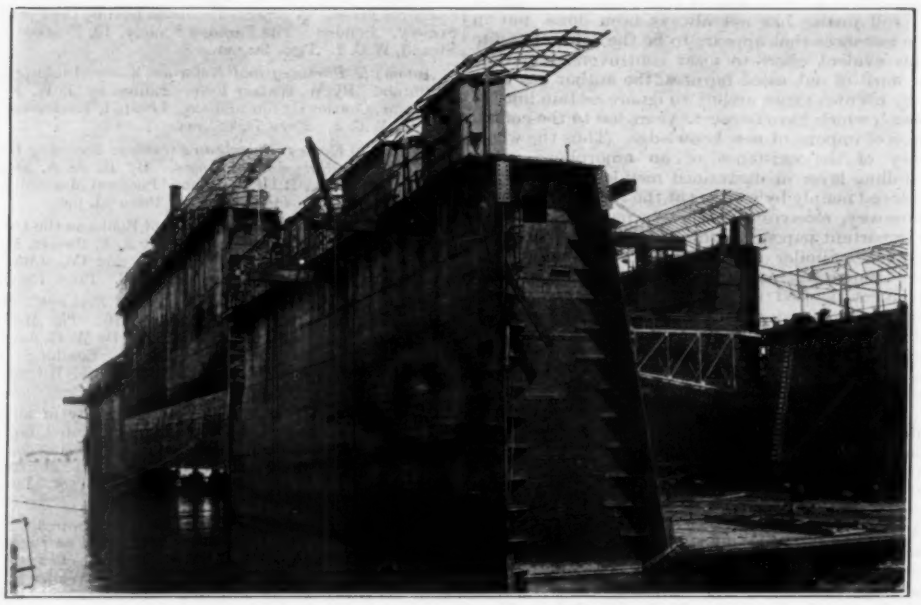


FIG. 2—VIEW OF DOCK SHOWING CENTRE SECTION RAISED

IRON AND STEEL INSTITUTE.

THE autumn meeting of the Iron and Steel Institute will be held, by permission of the Yorkshire Philosophical Society, in the Museum Theatre, York, on Tuesday and Wednesday, September 5th and 6th. At the conclusion of the meeting in York the members have been invited by Mr. C. P. Markham to visit his works at Staveley and the Parkgate Works, Rotherham, on Thursday, September 7th, and Friday, September 8th, respectively. The following provisional programme has been arranged:—On Monday, September 4th, the secretary's office will be open at the Museum of the Yorkshire Philosophical Society from 5 p.m. to 7.30 for the issue of badges, programmes, &c. On Tuesday, September 5th, 10 a.m., the secretary's office will be open, and at 11 a.m. there will be a meeting for the transaction of business and the reading and discussion of papers in the Theatre of the Museum. The meeting will be resumed in the afternoon at 2.15 p.m. Members are invited by Mr. William McConway, of Pittsburg, to attend at 4.30 p.m. a film demonstration in the Theatre Royal, York, descriptive of the new McConway process for the production of steel discs by centrifugal hydraulic methods direct from molten steel. On the Wednesday, at 11 a.m., there will be a further meeting for the reading and discussion of papers. At 3 p.m. there is to be a garden party in the grounds of the Yorkshire Philosophical Society, and visits will be paid, under the guidance of Dr. Walter E. Collinge, the Keeper of the Museum, to the ruins of St. Mary's Abbey, York, and to the Roman Wall, the Multangular Tower, the Hospitium and other Roman mediæval and modern buildings in and around the beautiful grounds of the Society. At 8.30 p.m. a conversazione, which will be followed by dancing, will be held in the Art Gallery of the City of York. Thursday, September 7th, will be devoted, as already stated, to visiting the Devonshire Works of the Staveley Coal and Iron Company, Limited, near Chesterfield. At 8 p.m. members will dine together informally in the Assembly Rooms, Blake-street, York. Friday, the 8th, will be devoted to visiting the works of the Parkgate Iron and Steel Company, Limited. Alternative visits to places of interest in the neighbourhood are being arranged.

The following is the list of papers which it is expected will be submitted at the meeting:—"The Changes of Volume of Steels During Heat Treatment, (1) Air Hardening Nickel Chromium Steels," by Mr. L. Aitchison; "Nitrogenisation of Iron and Steel by Sodium Nitrate," by Mr. L. E. Benson; "A Brinell Machine Attachment for Use with Small Specimens," by Mr. E. D. Campbell; "A Preliminary Magnetic Study of Some Heat-treated Carbon Steels," by Messrs. E. D. Campbell and Johnson; "Some Experiments on the Flow of Steels at a Low Red Heat, with a Note on the Scaling of Heated Steels," by Mr. J. H. S. Dickenson; "An Investigation on the Factors Influencing the Grain and Bond in Moulding Sands," by Mr. C. W. H. Holmes; "Practical Notes on the Manufacture and Treatment of High-speed Steel," by Mr. H. K. Ogilvie; "The Bases of Modern Blast-furnace Practice," by Mr. A. K. Reese; "Reversing Cogging Mills: Their Drives and Auxiliary Equipment," by Mr. G. A. V. Russell; "The Diminution of Lag at Ar 1 through Deformation," by Mr. J. H. Whiteley.

An American Highway Suspension Bridge.

To carry a public highway across the Snake River, near the city of Hansen, in Idaho, a suspension bridge of 608ft. span was adopted as the most economical type of structure, since the rocky canyon being several hundred feet deep the construction of piers in the river was economically out of the question. This bridge—opened in 1921—was built by the Midland Bridge Company, of Kansas City, to the designs of Messrs. Freygang and Trocon, engineers. Drawings of the bridge are given in the accompanying illustrations.

The four towers—braced together in pairs—are of steel frame construction without sheathing or covering, and each is composed of four main posts tapering from the base to the cap on which the cable saddle is seated. The foundations are simple concrete pedestals anchored to the solid rock, but, on one side, the edge of the canyon is broken away so that the foundations are at a lower elevation, and an 80ft. steel truss span carries the roadway from the end of the suspension bridge to the higher ground beyond, as shown in Fig. 1

An unusual arrangement of the cables is employed, each side of the bridge being suspended from a set of seven steel wire cables 1¼in. diameter, placed parallel, side by side and about 6in. apart. Each cable is continuous from anchorage to anchorage, and has its ends fitted with large cast steel socket pieces. At the towers the cables lie in grooved saddles and are securely clamped to each edge of the saddle. The sag or deflection of the cables is 60.8ft., or one-tenth of the span. They do not hang in vertical planes but are cradled or spread so as to be 20ft. between centers of the two sets at the middle of the span, 30ft. apart at the towers and 40ft. at the anchorages. A coat of black graphite paint is applied to the cables, towers and other parts, and where the cables rest on the saddles they are heavily coated with pitch.

The main cable anchorages—Fig. 2—are groups of eye-bars embedded in concrete, which is filled into pits in the solid rock. The socket casting of each 1¼in. cable is fitted over the legs of a 2½in. U-bolt 4ft. in length, being secured in place by hexagonal nuts. A 3¾in. steel pin lies in the loops of the seven U-bolts, and on this pin are threaded the heads of fourteen eye-bars ¾in. by 3in. in section and 21ft. 6½in. long. Packing pieces are placed between the eye-bar heads and the sides of the U-bolts. A similar pin passes through the eyes at the rear ends of the bars and bears against nine inclined pieces of 4in. rolled joists 3½ft. long, which serve to distribute the pressure in the concrete.

Over this rear pin are looped vertical and inclined bars with hooked ends, these bars lying in a rock pit at the end of the trench for the eye-bars. There are sixteen of these rods, ¾in. square. With the steel anchors thus assembled the trenches and pits were filled with concrete composed of one part cement to three parts sand and five parts crushed stone. All tension is thus transmitted by the concrete to the solid rock at the end of the anchorage trench. Where the eye-bars protrude from the anchorage block the face of the concrete is coated heavily with pitch to exclude moisture. At one end the cable anchorages are about 160ft. from the towers, and at the other end the distance is about 130ft.

Suspenders or hangers of steel rods are attached to equalisers clamped to the cables and have their lower threaded ends passed through sockets on the ends of the floor girders, to which they are secured by double nuts. Between the towers extend stiffening trusses 20ft. deep and spaced 17ft. between centers. Their upper booms are connected by transverse struts with diagonal lateral bracing of ¾in. rods. The floor girders are rolled joists spaced 16ft. apart and between these there is diagonal bracing in each bay. Stirrups or inverted U-bolts hung on the pins in the lower booms of the trusses carry bearing plates upon which the ends of the floor girders are seated. The floor has a camber of 4ft. 6in. in the 608ft. span.

A floor of transverse planks 3in. by 12in., 16ft. long, is spiked to lines of timber joists laid upon the floor girders. At each side of this floor is a curb timber or wheel guard. A guard screen is fitted to brackets on the truss posts to protect the truss members from being struck by vehicles.

Wind cables are arranged to hold the bridge in position and prevent undue lateral swaying. Each of them is a single 1¼in. cable forming a horizontal parabolic curve, with a rise of 61ft. in the 608ft. span. Each cable has its ends at one side of the bridge and its centre on the opposite side of the bridge floor, so that the two cables intersect at two points in the centre line of the bridge. These wind cables are secured in position under the floor by ¾in. U-bolts passed through holes in the bottom flanges of the floor girders. Forward of the towers there are spreaders placed between the cables, so that they act as a unit. The anchorages—Fig. 3—are similar to those of the main cables but on a smaller scale, there being only two eye-bars 5ft. long and six hooked anchor rods embedded in the concrete block in a pit cut in the solid rock. A point of difference, however, is the use of vertical rods hooked over the eye-bars to resist the vertical movement due to vibration or "jumping" of the wind cables.

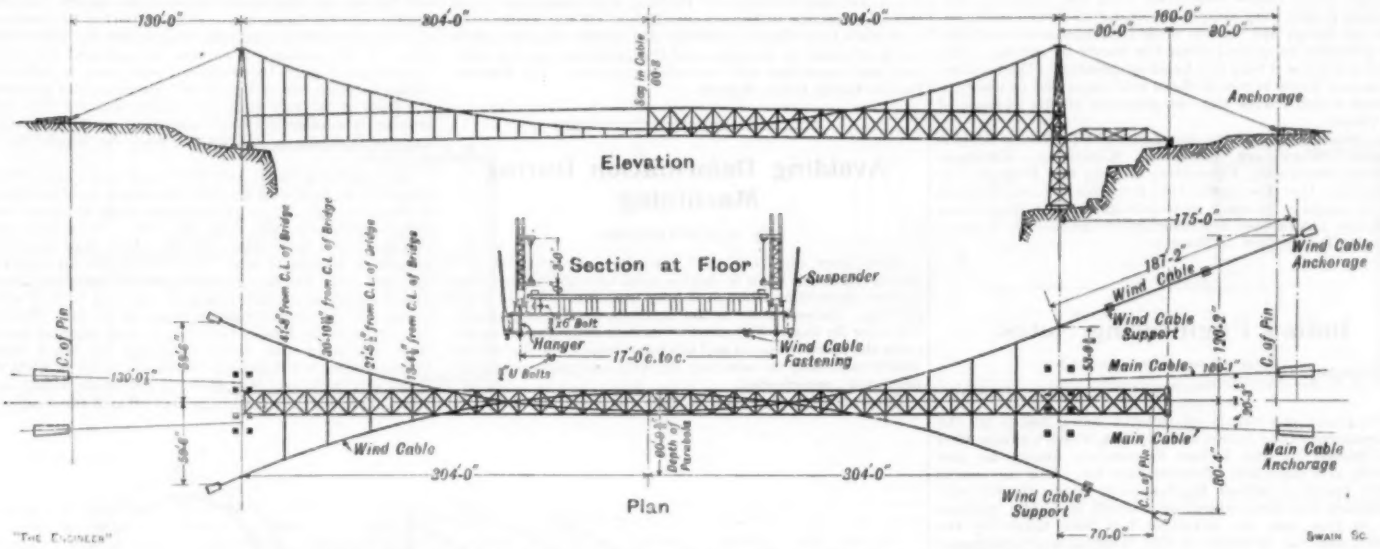


FIG. 1—ELEVATION, PLAN, AND CROSS SECTION OF SUSPENSION BRIDGE OVER THE SNAKE RIVER

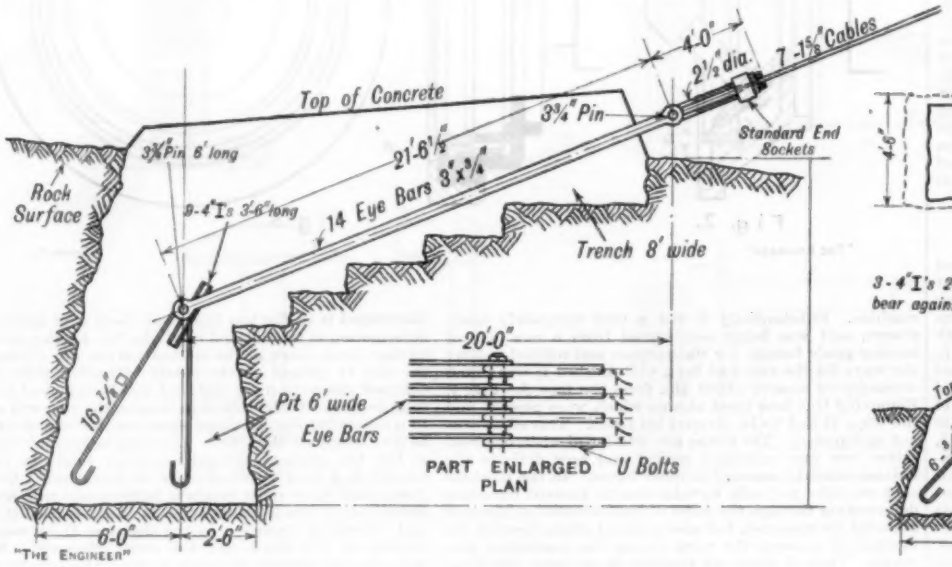


FIG. 2—MAIN CABLE ANCHORAGE

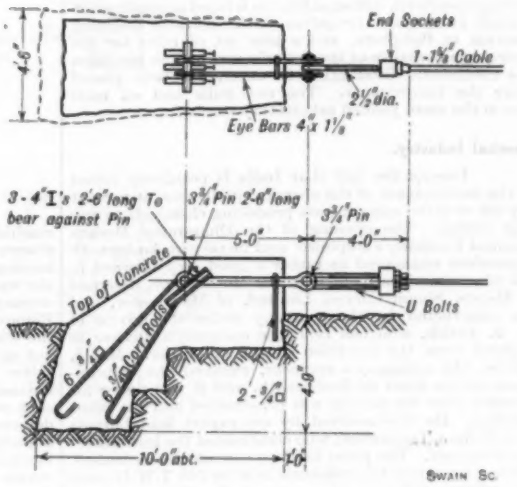


FIG. 3—ANCHORAGE FOR WIND BRACING CABLES

Antimony in China.

No country in the world, it is said, possesses such rich deposits of antimony as China, which already supplies 50 per cent. of the world's demand. According to the investigations of the Geological Survey of China, the Hsinkwangshan deposit (Hsinhua, Hunan) alone contains more than 2,000,000 tons of pure metal.

The first record of antimony ore in the Chinese Customs returns was in 1895, when a small quantity was exported from Shanghai. Business gradually developed with its centre first at Hankow, the head of the navigation for ocean-going steamers on the river Yangtze, and then at Changsha, the capital of the province, and 250 miles farther inland. During the war the metal was in great demand by munition manufacturers. The foundries in Hunan were maintained at high pressure to satisfy the calls from Japan, Europe, and America, and quotations rose from 150 dols. to 1000 dols. per ton of antimony regulus. This demand slackened when the war ended, and prices fell to the neighbourhood of 150 dols. In spite of this fall in price, however, production has been fairly well maintained, with the exception of a fall during 1919-20. In 1917 the trade in antimony regulus amounted to some 13,000 tons, and in 1921 it was, according to statistics published by the Chinese Government Bureau of Economic Information, at the rate of 13,800 tons per annum.

Antimony mining in Hunan first started at Hsi-Kwang-shan, more than twenty years ago. Probably the hill obtained its name because the inhabitants did not know the difference between antimony and tin, or because they considered antimony a variety of tin (hsi-kwang-shan means a hill with tin mines). The majority of the mines were not operated until the European war increased the demand beyond all recognition. New mines were then quickly opened and new companies sprang into being. Among the companies to come to the fore during the boom was the Huach'ang Company. In 1908 this firm secured the monopoly in China for the Herrenschmidt volatilisation process. Furnaces had already been installed at Changsha before the boom started. This process, of course, converts sulphide ores into tri-oxide, which is smelted for regulus in reverberatory furnaces. The Huach'ang Company also possesses Government rights for the exclusive production of regulus in Hunan. Other companies have very crude processes.

The method of mining is very simple. A hole is drilled into the side of the hill, and explosive material is put into

the opening. Then, with pickaxe and spade, the broken stones are removed and the cave is widened. The cost of sinking a 5ft. by 5ft. shaft is from 30 dols. to 70 dols. for every 10ft. At some places, the contractor, instead of receiving pay, shares the production with the company, taking from 30 per cent. to 80 per cent. He hires the workmen and provides all the equipment, while the company only furnishes the rights.

The deposits may be generalised as fissure veins with quartzite, and schist; and scattered deposits in limestone. Only one or two have been exploited to an adequate depth. There is usually no water in the mines, and pumping is therefore unnecessary. When rain gets through the shafts it can be easily drawn up in wooden buckets. Fresh air is supplied through bamboo pipes which are fitted with wooden pistons or a kind of cog-wheel mechanism to keep the air circulating. Sometimes, when the vein is not very deep, direct communication can be had with the surface through small shafts connected with the inclines. Ore dressing is also very simple according to native methods. The big lumps are broken with iron hammers, and the fine particles separated from the waste by sifting. The sieves are made of very fine bamboo splinters. The mixture of ore and waste is put in them and immersed in water, a process which leaves the ore particles at the bottom of the vessel.

Antimony is known to occur in eight provinces besides Hunan. They are Chekiang, Kwantung, Kwangsi, Yunnan, Szechwan, Kweichow, Hupeh, and Kiangsi. It is reported that the production from Kweichow, Yunnan and Kwangsi is growing in importance. The Huach'ang Company has erected Herrenschmidt furnaces in Yunnan near the Treaty port of Mengtze.

Indian Engineering Notes.

(From our own Correspondent.)

BOMBAY, July 7th, 1922.

GREATEST interest is at present being taken in the enforcement of the Indian Factory Act, which was amended and passed by the Indian Legislature during its last session, and came into effect on July 1st. This Act marks a new epoch in labour legislation in India, for till now legislation has come about as a result of public opinion, but in this case the initiative has been taken by the Government as a result of the Washington Conference. From certain inquiries made amongst the managers of mills and factories, I gather that the Act appears to be regarded as both a help and a hindrance. In many respects it will be productive of great good so far as the labourer is concerned, for it will mean that he will have more time on his hands to improve himself mentally and socially; but, on the other hand, because of the slow rate at which the Indian works, it is feared that there will be an adverse effect on production.

Mysore Developments.

Mysore State has now got a new Dewan—Mr. A. R. Bannerji, I.C.S.—and since his assumption of office the development of the State and its industries appears to have received a long-wanted fillip. A steady increase in the amount of electricity consumed for industrial purposes has manifested itself, and is explained by the additions to private installations which have taken place during the last year. In the preceding year there were 80 such installations in Bangalore and 32 in Mysore, while for the present period the figures stand at 116 and 52 respectively. The quantity of power utilised in these concerns, apart from the requirements of the Kolar Gold Mines, has increased from 3111 to 3647 horse-power. It is believed that the availability of cheap power, for which a scheme is being considered, will soon lead to a rapid multiplication of small industries. Irrigation works are also receiving attention in the State, and a new set of rules for the efficient maintenance of these works and for the provision of a continuous distribution of water, has been placed before the Government. The rice mills and oil mills have in the main yielded satisfactory results.

Chemical Industry.

Despite the fact that India is peculiarly suited for the development of the chemical industries, at present only six or seven concerns are producing chemicals to any large extent. The opening of the Dharamsey Morarji Chemical Company's sulphuric acid factory at Ambarnath is therefore considered as rather a good step forward in this direction. The plant is of the Moritz type, designed by Messrs. Simon Carves, Limited, of Manchester, and was constructed for the company under the advice of Mr. P. Parish, who has been the company's adviser in England from the inception of the enterprise. Mr. J. Barrow, the company's engineer, received the consignments of the plant at Ambarnath, and it was under his direction that the factory was constructed and the plant installed. He was assisted by six expert lead burners from Widnes, Lancashire, who constructed the lead towers and chambers. The plant has two cascade concentrators, which concentrate the sulphuric acid to 168 T.W.D., and can each turn out 5 tons of concentrated acid every twenty-four hours.

Cochin Harbour Scheme.

Considerable progress has been made in the last two years with this scheme. Work has been in progress on the foreshore, and an experiment in the shape of laying parallel stone groynes at the low-water level has been found satisfactory, the groynes having withstood the monsoon of 1921 and also prevented the rapid erosion of the sandy tract. The dredging operations have resulted in the completion of a channel over 2600ft. long, 150ft. wide and 18ft. deep, and negotiations are now in progress to obtain a more powerful dredger for the final deep channel over the outer bar, and so to the open sea, the course of which has already been marked out. It is understood that the Government of India will lend a 2000 tons dredger to supplement the work of the one already at Cochin.

In Brief.

Engineering progress seems to have come to a standstill in Bengal, and all that one hears from Calcutta are complaints regarding the inefficient water supply, the increased telegraphic charges and other things. The only constructive scheme on foot is one for the provision of better drainage in the city, but details are not as yet available.

The Bombay reclamation scheme has been making good progress, but the breaking of the monsoon has seriously hampered the work, and progress is very slow at the present time.

The Bombay Association of the Institution of Engineers (India) has been looking to the interests of its members, and a short while back arranged an interesting visit to the G.I.P. Railway workshops at Matunga, while more recently a paper was presented before the members by Mr. A. Lennox Stanton on "Railway Electrification," with special reference to Indian conditions. If the Association continues thus there is hardly any doubt that its popularity is bound to increase, and the perpetual cry for more and more members will be no longer heard. The Association certainly needs support.

Avoiding Deformation During Machining.

By A. WHITEHEAD.

How very far from rigid are the constructions with which engineers have to deal is soon brought home to the newest apprentice, though it may take him years to grasp it fully. Indeed, fully is too strong a word, for probably few ever do that. For most of us it is sufficient to appreciate the more common and obvious strains, the distortions which can easily be detected, or, with adequate experience behind us, anticipated.

Several years ago the writer was building a special machine. Substantially it was a very accurately made shaper, and was being constructed from a new one of inferior grade bought for the purpose and refitted. After the ways for the ram had been well finished it was found necessary to remove about $\frac{1}{32}$in. from the face A—Fig. 1. Removing this face freed strains which were present and the ways B had to be scraped up again. This effect was not anticipated. Yet it was not wonderful when one considers how any casting is cooled and how delicate the balance must be among the inner forces. In the machine shop we have not only to take care to prevent excessive deformation through the relief of local stresses as layers of material are removed, but also to avoid strain through the method of securing the work during the machining processes. There is great art required in accurate chucking. Nothing is ever made right, but most things are equal to their intended purpose: they are near enough. How near that is, depends on the purpose.

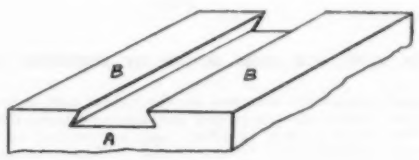


Fig. 1.

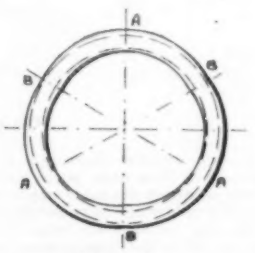


Fig. 4.

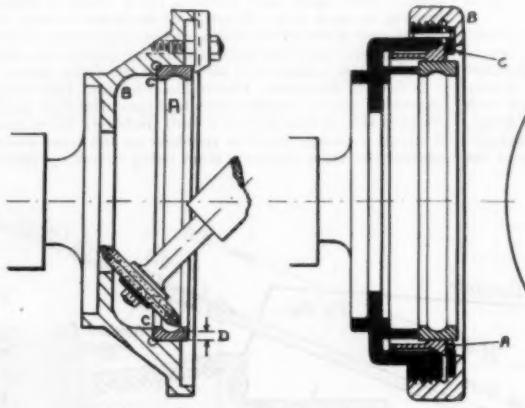


Fig. 2.

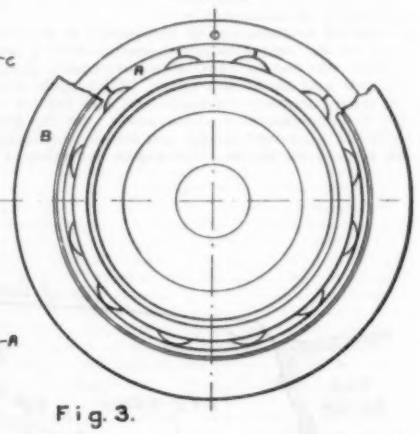


Fig. 3.

"THE ENGINEER" SWAIN SC.

CHUCKING A BALL RACE.

As an example, consider the outer ring of a ball race. This is a comparatively rigid object. But the permissible distortions from the ideal form are very small indeed in some directions; hence it is necessary to use extraordinary care in its manufacture. Once a part not truly round has been formed in an early process, the deformation may usually be traced despite any amount of care later on. For instance, chucking in a self-centering chuck may easily result in the shape depicted in Fig. 4, a ring with three lobes. To avoid distortion through chucking it is best to locate positively, but without pressure or force of any kind, in two directions and to clamp in a third substantially at right angles to both of the others. It is not otherwise possible to grip firmly without strain, except with great judgment or in very special circumstances; and only then when the article being secured is stiff enough to resist the clamping pressure in the selected direction. It is through ignoring this rule that many machining processes are defective and render subsequent correction necessary.

In Fig. 2, the race ring A is located in two directions by the register in the fixture B, and clamped in the third direction in the manner indicated. Even then there is room for numerous errors due to "spring" apart from defects in the machine. One clamp is depicted. The clamps must clear the outer radius or edge of A, or there is liability to deform the shape by pressure inwards: hence the formation of a lip at the end which beds on the work; or the heel of the clamp could be raised to produce an equivalent safety clearance. It is considered better to relieve the surface C of the fixture (on which the side of the ring beds) at intervals, so that the contacts are exactly opposite the clamps and not between them. Then, during grinding the slight pressure of the abrasive wheel will deform the ring more between the clamps than where rigidly held by them, unless it is supported by the register all round, which is generally impossible by this construction. If the number of clamps be increased the relief of the surface C must be modified; and there is risk of side-strain through the entry of dirt, or imperfect grinding of the sides of the race ring, or a faulty fixture. The risk of trouble is similar if three clamps are employed and the surface C forms a continuous ring on which the race ring beds.

But assuming the fixture to be true and round, the race ring may be faulty on its outer diameter, used for location. A common way of preparing these rings to avoid serious defects is to grind the sides flat first. Then they may be clamped on a face plate and the inner diameter may be ground to a definite size. By locating on an easy fitting mandril and clamping the sides firmly between a washer and a shoulder on the mandril, the ring is held without strain and the outside diameter may be ground. The grinding is preferably done in two stages, roughing and finishing, with seasoning and rough grinding the track between them, so that the finishing processes remove little metal from any part, and that little as uniformly thick as possible. The less the amount ground off and the more evenly distributed it is, the less likelihood there is of appreciable deformation in the finished ring. In Fig. 4 a ring is shown having three lobes. The dotted curves are circles. If the ring be ground on the outside diameter while firmly clamped sideways more material will be removed from A than from B. If the skin is in tension the ring will spring to a somewhat similar shape again on the outside as soon as the clamps are slackened. Grinding inside may improve it, but the original deformed contour tends to endure weakly in a kind of reflection of its former self. Clearly, then, since there must be slack between the ring and the fixture, an original deformation is easily carried through and shown by variation in the distance D between the bottom of the track and the outer diameter. Fig. 3 indicates one method of trying to avoid this serious defect even though the ring may, in its free state, be not perfectly round. In this device there is a ring A which is split nearly through lengthways in several evenly divided places, so that when the nut B is rotated the conical shape compresses the diameter in which the race ring fits. The washer C is prevented from rotating by the dowels shown, and thus the split ring is relieved from practically all except wedging action. It may be ground true and may be expected to remain substantially true over the small range of adjustment necessary. The worst trouble is dirt, which cannot well be kept out of the numerous cracks. The endways location of the race ring may be determined by three studs or a relieved surface may be formed on the end of a tube suitably fixed for the purpose. With this chuck in good order, clean and recently trued up, even if the race ring be a small amount out of round in the free state, it will become substantially correct in the chuck, and, therefore, the grinding of the track may safely proceed. This is an example of chucking which disobeys the rule mentioned previously, and distortion is

only kept very small by exercising great care in preparing the ring to be ground and in maintaining the chuck in specially good condition.

MACHINING A SMALL PISTON.

Another example of a difficult piece to produce accurately is that of the ordinary cast iron piston used in petrol engines. Here the deformation allowable is far more than in a race ring. Near the lower end of the skirt it is quite good if the maximum and minimum diameters do not differ by more than 0.002in. in the finished piston, if it be lightly constructed. Except when they are made in very small numbers the first machining process is usually turning the outer diameter and facing the crown while the piston is held on a chuck with expanding jaws, as illustrated in Fig. 5. There are numerous variations in the arrangement of these chucks according to the design of the piston to be turned. Fig. 5 shows the essential principle clearly. The piston is secured on two sets of four jaws, one set at each end, each set actuated through a hand wheel and rod (or tube) in the manner indicated. It

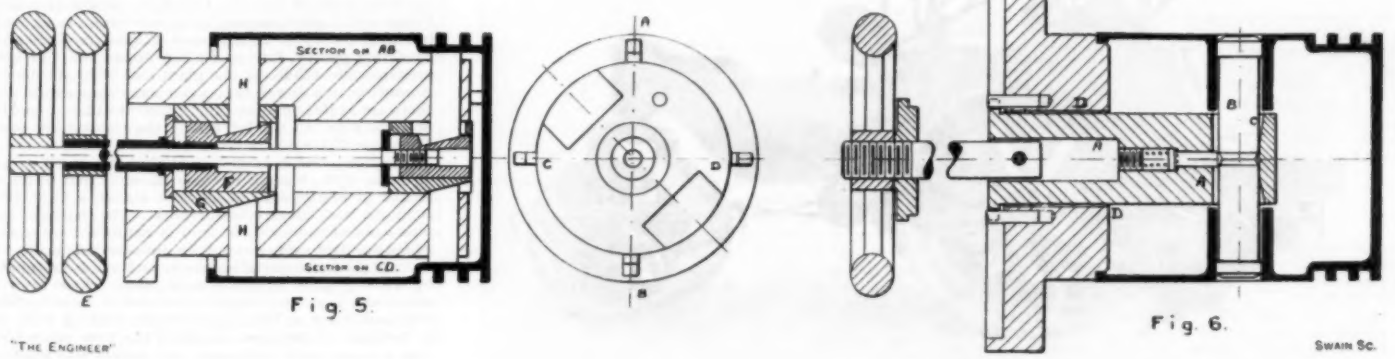


Fig. 5.

"THE ENGINEER"

Fig. 6.

SWAIN SC.

will be noted that the sectional view is composite, showing two half sections on different planes, A B and C D. Actually, opposing jaws symmetrically engage the same sliding piece, either both the inner, or both the outer. Rotating the hand wheel E causes F to slide in G and thus the jaws H are forced out or permitted to slide in under the action of springs which are not shown. Neglecting friction, this arrangement causes the four jaws in either set to press equally on the piston walls. Sometimes two sets of three jaws are used with one hand wheel. That design is simpler but not so good because, owing to the gudgeon bosses, the jaws cannot be evenly spaced, and the distortion is much greater with three than four jaws. At this early stage, however, the deformation through chucking is not vitally important. The skirt is sure to be far out of round and will alter with seasoning. After the first rough machining on the eight-jawed chuck, the next process is to hold the crown end in a self-centering chuck and to face the open end and bore it to a definite size for registering the position of the piston in the jigs or fixtures used during succeeding operations. This size is usually rather less than it will finally be made when the pistons are adjusted for weight; hence sufficient metal may be left to give reasonable stability to this diameter during production. The next step is to rough out the gudgeon pin hole. Succeeding locations may all be in the manner shown in Fig. 6. Here the piston locates on a spigot, and is held against the face of the fixture in the manner indicated. A loose fitting pin passes through the gudgeon hole and is centralised by the groove in it and the spring plunger in the centre of the piece A. Turning the hand wheel clockwise causes the bolt to draw back the piece A and hence the piston is forced against the fixture. But several refinements are desirable to prevent deformation as far as possible. The piston is definitely located by the spigot and face at its open end. Consequently the pin B must be free to float in every direction so as not to quarrel with other parts in trying for its own way. Preferably it bears on the ends only, as shown, so as not to deform the shell by bending the bosses towards the fixture. It may rock in A because the hole is cleared at C to permit oscillation; and A is a floating fit in D to allow for any other inequalities to be adjusted. If desired B may drive the piston around positively without appreciably deforming it. Yet since the shell is very thin and cannot be perfectly supported at the open end, it is not possible to produce, even in a workshop sense (not academically) a round piston. The registering diameter may be trued to a new size preparatory to grinding the piston on the fixture depicted in Fig. 6, to eliminate much error. But even then there will be slackness in the fit on the spigot; and the thinness of the shell, the slight rise in temperature while grinding, and other disturbing factors, cannot be prevented from having some effect.

HOLDING A SMALL ARMATURE.

The last example is quite in a different class. Yet, in principle, the method is the same as already described for holding during the process of machining. Fig. 7 shows a magneto armature. It is built from two end pieces (shown in Fig. 8), riveted together, with several soft iron laminations in between. Every part of this structure is flimsy. Yet it has to be machined cheaply and the end spigots must be correct within about 0.002in. It is customary to grind the large diameter after the armature has been wound and the end plates, which fit on the spigots, secured. In that state it is delicate enough, but not much has then to be done to it. It is the earlier processes which give trouble. The end pieces—Fig. 8—are of soft iron and the crossbar, therefore, has no strength worth mentioning. Where machining is done before the pieces are riveted together is shown by "whiskers." Dimension A is finished before the assembling takes place, but the machining at B, C and D is for locating the pieces in the drill jig and riveting fixture. When the various parts are loosely threaded on the rivets they can be entered into the riveting fixture under perfect control within limits. Faces B and D locate each end piece; faces C prevent inward collapse, there being supports to engage them on the fixture; the laminations locate direct from the rivets; clamping is endways, so as firmly to compress the laminations. Now, having reached this stage, the problem is to complete the machining quickly and accurately. By registering off the faces B and D the core can be located as it was for riveting, and clamped firmly, leaving inside the jaws clear all round. Then, with a profile milling fixture the core can be finished on all the inside surfaces in Fig. 7. The final process, turning the outside diameter and the end spigots, may be done in one chucking with a fixture in principle like Fig. 9. In this the core A locates in one direction by the jaws fitting on the flats B. In the second direction control is by the crossbar fitting in the groove C; and lastly, the clamp plate D compresses the core endways with sufficient force for it to sustain the cutting tool pressure. E, the body of the turning fixture, screws into an adaptor or is otherwise secured on the spindle of the lathe. It and the clamp are suitably relieved so that each end of the core is bedded on four spots. This is possible because the core readily yields, the price being a certain amount of deformation, but not enough to be troublesome. The plate D locates through dowel pins so that it is positively fixed with respect to E and so will not foul the cutters through being placed incorrectly.

Thus these examples illustrate the application of the rule given as regards locating positively in two dimensions of space and in the third, also positively, by firm clamping. But in the first two ways it is safer to avoid any means of adjustment, for means of adjustment are certain to be also means of deformation.

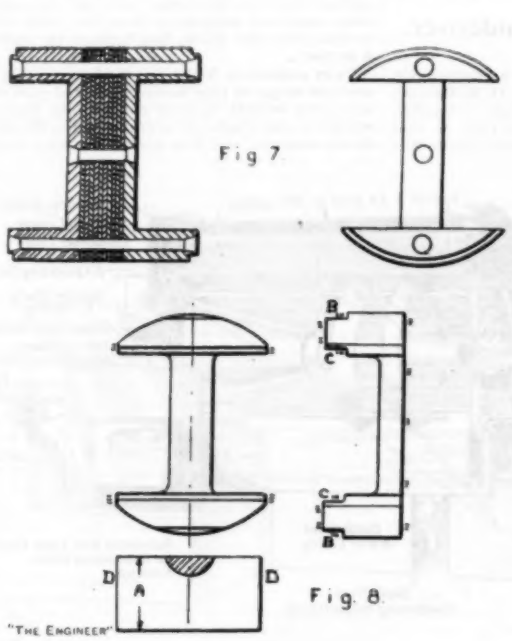


Fig. 7

Fig. 8.

"THE ENGINEER"

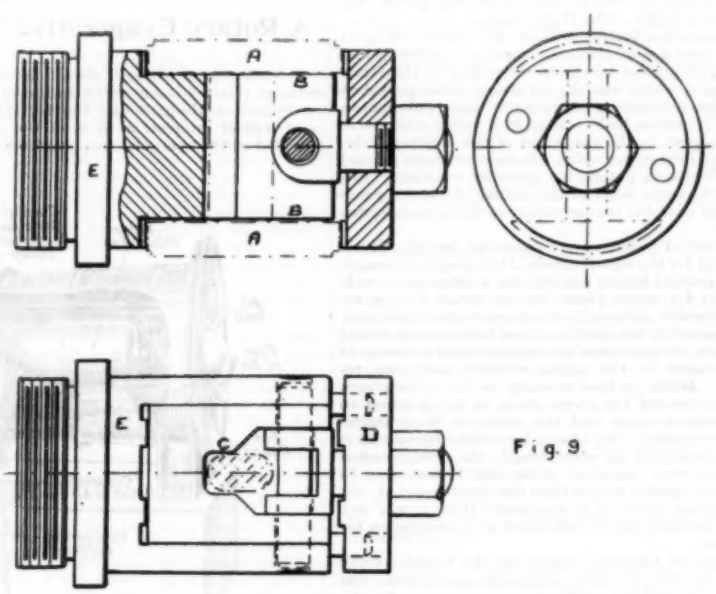


Fig. 9

SWAIN SC.

SINGAPORE ELECTRICAL SUPPLY.

THE following is a *précis* of a report submitted by the electrical adviser to the Government of the Federated Malay States on the public supply of electricity for power and light in Malaya.

Although for some years the various areas of supply in Malaya will be isolated from each other, it is practically certain that all public supplies from Singapore to Penang will eventually be connected together to form one supply. The total cost of reconstructed and new installations to meet the full demands of the present population is put at 37,136,000 dols., and the kilowatt capacity at 51,120. This is for the whole country, including the Unfederated States.

It is recommended that in Singapore a central power station should be erected to supply light and power to an area of about 30 square miles, replacing the present supplies which are obtained from the tramways and the Singapore Harbour Board. The system of supply would be alternating current, three-phase, with a frequency of 50 cycles per second. The extra high-tension transmission lines would be run at 22,000 or 33,000 volts, and the supply made to domestic consumers at about 240 volts. For large power demands, electricity could be supplied at any intermediate pressure required. The capital cost of the new and re-organised supply for Singapore is estimated at 5,167,000 dols. It is anticipated that a steam station of 7500 kilowatts could be installed, and, later on, as demands increase, extended to a capacity of about 18,500 kilowatts, which, with additional transmission lines, sub-stations, feeders, distributors and house services, would necessitate a further expenditure of 1,273,000 dols., making a total capital cost of 6,440,000 dols. It is calculated that within a few years the demand for electricity in Singapore will be about 8,700,000 units per annum for domestic use, &c., and that, in time, the demand will rise to 23,400,000 units per annum.

Prolongation of Letters Patent.

A CASE recently heard in the Chancery Division and not yet reported raised some interesting points regarding the prolongation of letters patent. The law as it now stands gives the Court power to prolong a patent for five years or in exceptional cases for a term not exceeding ten years. The term was limited to these figures under the Act of 1919, in substitution for the terms of seven years and fourteen years respectively. In order to obtain the benefit of prolongation or the grant of a new patent the inventor must be in a position to prove that the invention was one of sufficient merit and that he had been inadequately remunerated. To obtain an extension greater than the shorter period the patentee must further prove to the Court that the case is an exceptional one—that it to say, an invention showing exceptional merit. Very few patents have been extended for terms much longer than the shorter of the two terms. Under the Act in which fourteen years was the longest term for an exceptional case only three patents were extended for such a term as ten years. Of these, Stoney's patent relating to sluices and flood gates had a very limited chance of use; Darby's patent for a steam digger was held to be of exceptional merit; and Currie and Timmis' patent for electric operation of railway signals was a case in which the patentee obtained no sufficient remuneration. These three cases were decided by the Judicial Committee of the Privy Council, which alone heard prolongation petitions until a comparatively recent date, when the power was transferred to a Judge of the High Court.

In later years the following cases are among the most important. The Lodge patent of 1897 for synchronised telegraphy without line wires was extended by the Court for seven years, which was the maximum short period at that time, the petitioners alleging that their attempts to develop the invention had resulted in a very considerable loss owing in part to the operation of the Wireless Telegraphy Act of 1904 under which a licence had been refused to them. Ferranti's patent for spinning machinery was also extended—as to some of the claims—for seven years in the ground that the remuneration of the inventor was inadequate.

In 1917 several patents were extended by the Court. Creed's patent for the reproduction of telegraphic messages in ordinary printed letters suitable for a telegraphic code was extended for seven years, the inventors having received considerable, although not adequate, remuneration. Trantom's patent for the purification of brine was extended for three years, the patentees having developed a process of great importance to the public without adequate remuneration. Inglis' patent relating to fire tube steam boilers was extended for seven years, it being found to have considerable merit and the patentee being inadequately remunerated. The case is important because in it there was considered at some length the "exceptional cases" which were intended under the Patent Act to receive a prolongation longer than the shorter period, but in this particular instance it was found that it was not such an exceptional case as admitted of an extension for fourteen years.

An extension of Fleming's patent for the Fleming valve was sought, but the invention, although meritorious, was found to have yielded sufficient remuneration to the inventor. This is a case, therefore, that needs careful consideration by those seeking to apply for a prolongation of their patents. The Michell thrust bearing patent was extended for seven years on the ground of inadequacy of remuneration. A patent by Fleming and Gale is interesting because it is one of the rare cases of extension of an invention requiring small inventive ability. The invention relates to otter boards for trawl nets, was of great practical utility, and protection was extended for three years.

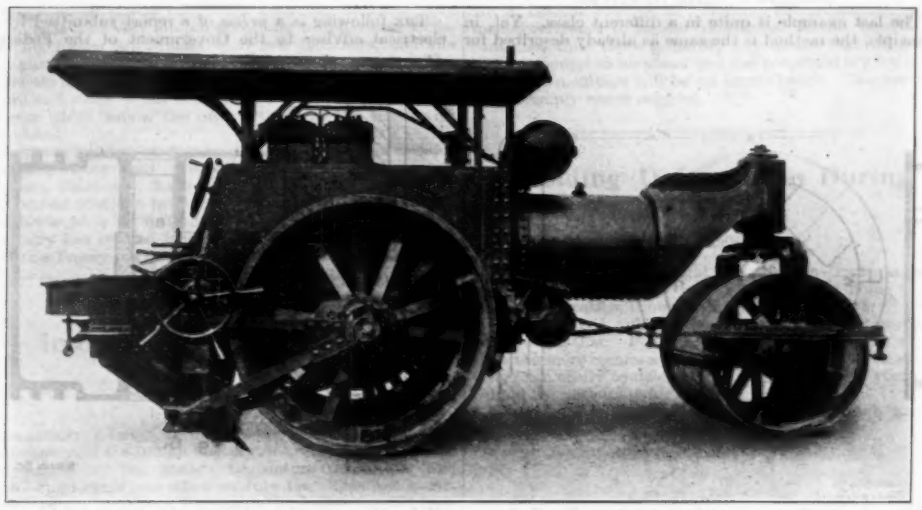
Many other cases of extension might be cited, but the few given above will serve to show the general nature of the grounds on which the prolongation of patents are granted, and the kind of term usually given. According to the Comptroller's report at the end of 1921, twenty-two patents which had been prolonged beyond the normal period were in force.

IT is proposed to construct an electric tramway in Hangchow, China, and to generate the necessary current by hydraulic power on the Chien River.

Motor Road Roller.

WITH reference to the description of a motor road roller with scarifier attached, which appeared in our issue of June 30th, and which we referred to as probably the first motor roller to be so fitted, the Oxford Steam Plough Company, Limited, of Cowley, Oxford, has sent us a photograph, of which the accompanying block has been reproduced. The illustration represents a Laffly-Aveling motor roller, to which the Oxford Company informs us it some time ago fitted an Allen scarifier, so that it claims to have been the first in the field in this particular direction.

The scarifier is fitted to the roller by means of draw-bars taken outside the wheel to the hind axle. There is also an inside draw-bar taken from the frame to the horn plates. The vibration, it is pointed out, is absorbed by a patented arrangement of wood cushion blocks between the tender of the engine and the scarifier. The scarifier can be used in a forward direction, so that the steering gear of the engine is not affected, and it is claimed that the tynes, coming as they do close behind the tread of the hind roller wheel, follow the undulations of the road closely, while the leverage on the engine is reduced to a minimum. We may add that the Allen scarifier was illustrated and described in our issue of June 13th, 1919.

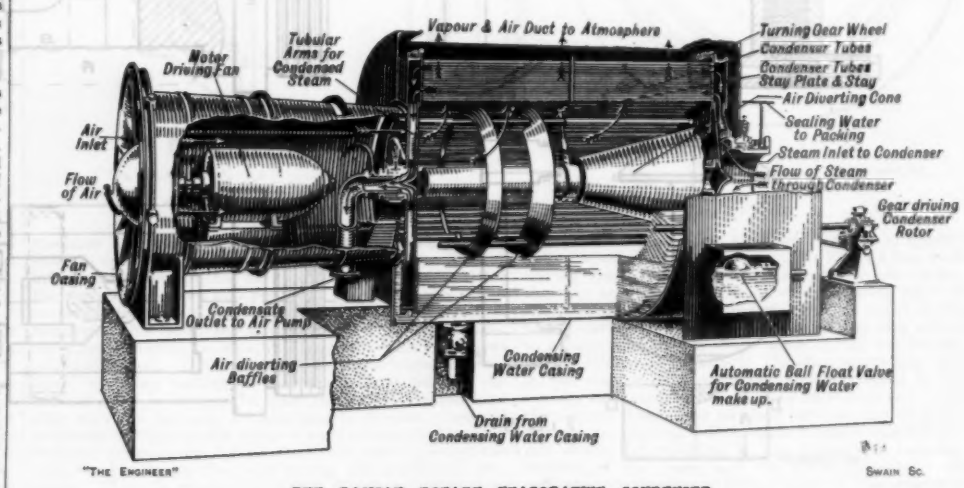


MOTOR ROAD ROLLER FITTED WITH SCARIFIER

A Rotary Evaporative Condenser.

THE steam condenser shown in the accompanying drawing, which is made to the designs of Mr. D. M. Ramsay by Fullerton, Hodgart and Barclay, Limited, of Paisley, is of topical interest, as it is of the same type as that installed on the new condensing turbine electric locomotive described in our issue of March 24th last. The condenser is, however, not necessarily confined in its application to locomotive work alone; it is being put forward for general service where cooling water is scarce, and it is nevertheless desirable to have a high vacuum. It is, in fact, claimed that this condenser requires only 1 lb. of water for every 1 lb. of steam condensed, and that it will, at the same time, maintain a vacuum of 29in.

On reference to the drawing, it will be seen that the active part of the condenser comprises a cage of small tubes expanded into two headers and mounted on hollow trunnions. One of the trunnions provides a means of ingress for the steam to be condensed, while the other forms an outlet for the condensate and the incondensable gases. The header at the inlet end is divided up by a number of radial partitions, and there is a baffle at this end, which blanks off the lower sector-shaped partitions. In this way the steam is guided into the upper nests of tubes and kept away from the lower part.



THE RAMSAY ROTARY EVAPORATIVE CONDENSER

The whole cage is slowly rotated by mechanical gear in a tank which is filled with water to such a depth that all the tubes are, in turn, immersed. As the tubes rise out of the tank they are covered with a thin film of water, and it is the evaporation of this film, under the influence of a strong draught produced by a fan, that absorbs the heat given off by the steam in the process of condensation. This draught of air enters the cage of tubes at the opposite end to the steam, and after being distributed by a number of baffles escapes at the top of the casing.

It is, of course, necessary that the two trunnions should be kept air-tight, and to this end they are equipped, not only with stuffing-boxes, but also with a water service for sealing purposes.

A LONG WELDED STEAM PIPE.

AN underground steam pressure main, 3575ft. long, welded up in one piece, except for the expansion joints, has been built at Dayton, U.S.A., to enable the Dayton Power and Light Company to supply steam to two manufacturing plants for heating and process purposes and for operating pumps, fans and other apparatus. The steam pressures are 125 lb. at one plant and 75 lb. at the other. According to a description given some time ago in *Power*, there are 1145ft. of 14in. pipe, 1321ft. of 12in., and 1109ft. of 10in. pipe, all welded up by the electric arc process. There are 274 welds in all.

The pipe is laid in a concrete conduit at a depth, as a rule, of about 4½ft., though in some places it had to go down 8ft. or more to pass under water mains, sewers, electric conduits and other obstructions. The bottom of the pipe conduit is 6in. thick, and is reinforced by iron bars which are bent up to extend 8in. into the side walls. Four right-angle bends were required, and these are anchored by welding them to rolled steel joists, which are cut to shape and have their ends embedded in concrete blocks. One such bend in 10in. pipe is welded into a 14in. main. A vertical reverse curve enabling the 12in. main to pass over a water main and under two sewers was built up of seven short pieces of pipe welded together.

Pipe covering of two layers of 3in. asbestos-cell sectional sponge felt, secured by bands and laid to break joints, both longitudinally and circumferentially, was applied. This covering was then wrapped with expanded metal tied in place, and over all was laid a ½in. hard finish coat composed of equal parts of Portland cement, plasterers' sand and insulating material. Pipe fittings were covered in the same way, the felt being applied in sections and the metal lath cut to fit.

To provide substantial supports and to maintain the pipe in alignment during its longitudinal expansion and contraction movements, special guides are fitted at intervals of about 30ft. The base is a casting anchored to the floor of the conduit, and the upper part is a sliding element clamped to the pipe. An opening in the base casting provides free drainage along the conduit. After the pipe line had been completed, saddle plates were fitted under it to prevent any sagging or dropping of the covering between the guides. The saddle was pressed up tightly against the pipe covering, and the support carrying a roller was then wedged up from the floor of the conduit so that the roller would bear against the saddle and hold it in place.

Twin expansion joints are used, consisting of a nipple or short length of pipe having the fixed part of the expansion joint welded to each end. Cross frames were also welded to the nipple, to be embedded in the concrete walls of the manhole, and thus anchor the joint in place. Each joint provides for 7in. of slip, and the two joints are enclosed in a single manhole.

QUESTIONS have been somewhat frequently asked in the House of Commons of late as to the Halwill and Torrington Railway. The first sod of this new railway was cut the other day by Mr. Arthur Neal, the Parliamentary Secretary to the Ministry of Transport. Torrington is the terminus of the London and South-Western Company's North Devon lines whence, to Peters Marland, is a derelict private mineral branch which will require reconstruction. Halwill is the junction of the Bude branch of the London and South-Western Railway with that company's Exeter-Plymouth main line. There will thus be improved communication between North and South Devon.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Midland Blast-furnaces Re-start.

IT is pleasant in these times, when other districts report the blowing out of blast-furnaces, to be able to record, as I am this week, the re-starting of furnaces in this district, even though they are not of very large capacity. When one recollects that out of fifty-eight blast-furnaces in Staffordshire, Shropshire, Worcestershire and Warwickshire forty-five are idle, the profoundly disquieting state of affairs is at once recognised. It is encouraging, therefore, to learn that two additional blast-furnaces have this week been started—one each in Northampton and North Staffordshire—both producing foundry material. Another Northampton furnace is to start in a few weeks. In South Staffordshire, unfortunately, plans for resuming the production of forge and foundry pig appear to have been abandoned or postponed owing to the heavy loss which it would entail. Smelters were relying upon a real relief from the railway companies in the way of reduced rates, and those which are now about to come into operation are considered negligible. Sales of pig iron continue to be restricted to small lots, and while demand has improved, it is easily met out of the present limited output. The fact that some transactions have recently taken place for forge iron promises relief in some directions, forge iron having been practically unsaleable by reason of the stagnation in the Staffordshire iron trade. The slight improvement in engineering has stimulated buying of foundry material, but as a rule the business is for small lots, partly on account of financial stringency. Recent quotations are upheld. Strong efforts have been made to secure reductions in prices, rather attractive tonnages being offered, but in many cases such reductions have been refused. Smelters, from their own point of view, are rather shy of forward contracts, in view of the prevailing uncertainty.

Reduced Value of Common Bars.

The Staffordshire iron mills appear to be getting a little busier, but the prevalent underselling, especially in the departments devoted to the manufacture of bars of nut and bolt and fencing qualities, is strongly complained of, some makers asserting that current prices involve a loss of at least £1 per ton. In normal times 30s. per ton is regarded as the proper difference between marked and unmarked bar iron, but in recent months the common grades have undergone a series of cuts, which have brought merchant qualities down to £11 and upwards, nut and bolt iron to £9 17s. 6d. to £10, and fencing iron to £10 2s. 6d. This week the disparity has been made even greater by the action of many Staffordshire ironmasters, who have reduced their quotation for nut and bolt bars to £9 12s. 6d., and in some cases even to as low as £9 10s. Foreign competition in this branch has intensified of late, Belgian ironmasters in particular bidding strongly for a share of the iron supply. Belgian bar makers have taken a number of good orders out of the Black Country this week. It is understood that last week's price of £8 12s. 6d. has been shaded in order to achieve this result. The material is only suitable for nut and bolt making or fencing, and its variable quality, even for the former use, makes consumers regard it with suspicion. Most makers, happily, prefer to take Staffordshire material now that it can be obtained at £9 10s. The retention of the marked bar standard of £13 10s. has had a steadying effect on the better qualities of unmarked bars. North Staffordshire mills still quote £11 15s. for merchant iron. That price is not paid, however, unless the requirements are very exceptional. For good class merchant iron £11 is not the minimum. A fair amount of business is reaching the mills, but there is still room for great improvement.

Galvanised Sheet Prices.

Galvanised sheet values have this week firmed up again, and though the low prices quoted last week have not disappeared—some South Wales makers competing for the business unrestrictedly—a number of firms have now adopted £16 f.o.b. as their basis price for 24-gauge galvanised corrugateds. This means an increase of fully 10s. per ton on some of the quotations previously applying. Individual firms have put their price as high as £16 10s. Black sheets, 24-gauge, are £12. It is understood that the stiffening up has been undertaken without any binding agreement, the hope being that it will consolidate the position, which has been weakened by the inconsistencies of prices.

Belgian Steel Competition.

There is a slightly improved business in steel this week and the steel rolling mills are reported to be better employed. There has been a better call for Staffordshire hoops at £12, though Lancashire mills still appear to have the major portion of this business. Bedstead tubes this week realise £11 10s. and ordinary steel strip £11. Gas-making strip can be bought at £10. Bedstead angles fetch £9 10s., rod wires about £11 10s. delivered. There are indications of an intensification of foreign competition in semi-finished material. A proportion of the sales this week has related to this material, which is decidedly cheaper owing to the fall in franc values. Quotations have been received from Belgium for billets at £5 15s. f.o.b. Antwerp. The easing of the railway rates has reduced the rate for delivery in Birmingham, which is now £1 3s. 6d., making the total price £6 18s. 6d., a price low enough to attract business. Larger-sized billets of 4in. can be bought at £7 5s. One Staffordshire firm with a reputation for a good welding billet claims to be getting £7 15s. and continues fairly busy. At the same time a few keen buyers have taken advantage of Belgian offers to make contracts quite satisfactory to themselves. The decision of the Welsh steel makers to abandon price regulation has been stimulated by this foreign competition. Billets can now be bought in Birmingham from South Wales at £7 5s. A fortnight ago a local firm quoted £7 15s. after booking a fair aggregate tonnage, but it is believed that no business was done at this price. Very little has been heard of finished steel, but here and there very low quotations are in the market, representing a cut of quite 10s. below British prices. As the currency slump is believed to be temporary, some of these quotations are accompanied by a time limit.

The Edge Tool Trade.

There has been a decided improvement in the volume of business done by the local heavy edge tool makers in recent weeks and this movement for the better steadily increases. Although there has been no jump in business, the signs are considered favourable towards a healthy movement, especially in the foreign order department. From countries where there is more money in circulation, as the result of good crops, more orders are coming in. Prices remain fairly stable, having reached what may be regarded as the bottom limit.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

General Outlook.

ALTHOUGH there is a vague idea in the Manchester market that business is not so quiet as it was, one cannot find any definite improvement to report, and it is perhaps true in this case that the wish is father to the thought. The dulness of trade in this district has continued for a long time. During the lock-out of the engineers we were all more or less comfortable about it, assuming that when the works were open again trade would at once revive. There was, it is true, a little movement a week before and a week after the settlement of the engineering dispute, but this has been all, and dulness has settled down again upon Manchester and the surrounding district. People are now forced to look forward to the autumn and the end of the holiday season for a revival of business, although it is difficult to see why it should come even then. The reports of those who call regularly upon the engineering firms are certainly very gloomy.

Metals.

The market for copper, of course, does not depend upon the local state of trade in Lancashire, and this latter might be very bad while copper was booming; but the general condition of copper consumption throughout Europe is not encouraging just yet. On the other hand, American consumption is still said to be good and on the increase, and there are continual reports of labour shortage, which may check the increase in production. One does not know here what credence to give to these reports, which may be one of the many ways adopted in America to induce customers to hold larger stocks; and in any case there is little chance of any great improvement in the European consumption until the finances of Europe are in a better condition. It is perhaps worth noting that since the last week in June standard copper has advanced by £2 per ton, whereas best select ingot copper has not advanced at all. The difference between standard and best select, as we write, is only £2 10s. per ton. At the same time electrolytic copper stands at £4 per ton above the price of best select—a very unnatural condition of things, because intrinsically there is little or no difference between these grades beyond, perhaps, ¼ per cent. in purity. The prices for manufactured copper and brass have not been altered up to the time of writing, and consumers resent very much having still to pay "war" prices for these materials. One cannot say exactly how far the manufacturing costs have been reduced, but it is obvious that under a freer system of competition manufactured materials would be far cheaper than they are at present. The rise in tin prices seems to have caused some surprise, especially in this district, because the feeling of merchants was adverse to the prospects of the market. There are rumours that a new "bull" campaign is preparing in tin, and perhaps this is based on the belief that the shipments from the Straits will soon begin to show a reduction, or it may be that there is some connection with the report that a powerful syndicate was negotiating to take over the holdings of the Federated Malay States Government. In this country there is not a great demand for tin, but the American consumption is good, and the view taken there seems to be that tin is a safe metal to hold at the present level of values. Lead has again shown considerable strength, and the prices are not far below those of last autumn. The present value should do something towards stimulating production. Interest in the spelter market is reviving as a result of the recent firmness and slight advance in the price. There is some improvement in the consumption of spelter, galvanisers taking a fair quantity and brass makers beginning to buy again.

Foundry Iron.

The demand in Manchester for foundry iron is perhaps a little less than it was. Consumers are not buying iron until they want it, as they have no belief in prices and do not expect them to go higher, and the amount of foundry work being done in the district is small except in those foundries which have textile machinery orders. General work is poor, and the total consumption of pig iron cannot be large until this class of work becomes more plentiful. The usual quotation for No. 3 pig iron delivered in Manchester is still 91s. per ton, and for the most part this is Derbyshire iron. A fortnight ago there was some talk of the demand for iron being greater than the output of the furnaces which are at work, but this does not now seem to be the case, and there is no talk of lighting up more furnaces. Of course, there are several furnaces only waiting for a chance to light up, and it is the knowledge of this fact which makes consumers of iron confident that prices cannot advance except for a very short time. Some interest is taken here in the rumours that America will be buying large quantities of iron, but so far one does not see any effect of these rumours on the price of Cleveland pig. The latter is still quoted at 88s. per ton at the furnaces, and is rather a weak market at this price, the local consumers holding off in the expectation of a further fall. Of course, if America should buy in large quantities some effect might be produced even in the Manchester market for pig iron.

Finished Material.

The market here for manufactured iron and steel is, if anything, rather quieter than it was, and the orders coming in are for trifling quantities. The local prices are not affected, but the anxiety of the steel works for new orders is shown by the fact that for export they are quoting prices very near to those current on the Continent. One hears that orders for sectional steel for shipment have been taken at £8 5s. per ton, and, of course, this kind of thing makes the home consumer very dissatisfied with the prices he is called upon to pay.

Scrap.

There is no change of any importance yet in the market for scrap material. Ironfounders are buying cast scrap very sparingly, and the dealers continue to quote 80s. per ton for it. As good quality is 11s. per ton cheaper than common pig iron one would think that the foundries should use as much as possible; but in the case of textile machinery the buyer may often insist upon the usual mixture of Scotch and ordinary iron. Heavy wrought scrap does not seem to be any more plentiful, and dealers are still hoping to get a better price for it.

The Engineering Trades.

In most branches of the engineering industry in this part of the country the long-looked-for revival of trade has not yet made itself felt, although there is a feeling that "things are on the turn." Nearly all firms report that inquiries are much more numerous than has recently been the case, and if only a small proportion of the inquiries materialise the outlook will improve. Probably the best indication of the state of trade in this district is to be obtained from the reports of the labour exchanges, and unfortunately these do not as yet show any material improvement. On the "live" register for Lancashire and Cheshire there were 247,568 persons totally unemployed and 16,243 on short time last week. These consist largely of textile operatives and engineering workers. Lancashire's industries depend almost entirely upon foreign markets, and many of these are now nearly non-existent. New markets will have to be found pending the unravelling of the tangle arising out of the problems of reparations, inter-allied debts, and the foreign exchange, which is holding up free interchange of trade with the great European markets. The only really bright spot in the engineering industries of Lancashire at present is the textile machinery section, which is well employed on orders for abroad. The heavier side of the electrical trade has also maintained a good average throughout the long period of depression, but apart from these branches the state of the industry leaves much to be desired in Lancashire.

Manchester Ship Canal.

The traffic receipts of the Manchester Ship Canal for the first half of this year show a material improvement upon those of last year, when the canal was badly hit by the coal stoppage. The traffic receipts for the half-year ended June 30th, 1922, show an increase of £86,887 over the corresponding period of last year. The net revenue for the half-year shows an increase of approximately £100,000 over the corresponding period of 1921, after making provision for increased interest and other fixed charges.

The Engineers' Club.

In spite of the depression in the engineering trade of the district, the Committee of the parent Engineers' Club, Manchester, has decided to proceed with the extension of its premises, and work is now in progress on the adjacent building, which will form the first portion of the ultimate scheme of extension which was decided upon some time ago. The immediate expansion will only affect the dining-room accommodation, which will be greatly increased. It is hoped shortly that other extensions will be carried out which will make the club one of the finest in Manchester, and enable the limit of the membership to be increased considerably.

BARROW-IN-FURNESS, Thursday.

Hematites.

There is little or no improvement in the hematite iron trade, and most business done is confined to ordinary mixed numbers. There is very little demand for special iron with low phosphorus percentage at present. Still, there is confidence in the market, and it seems to be simply a question of waiting for the engineering trade to improve in the first place and then for the shipbuilding industries to show more life. From reports it would seem that the engineering trades are showing signs of improvement, but the movement towards brisk trade will be slow. On the other hand, the oversea trade is increasing, and a part cargo for Kobe, Japan, was shipped last week from Barrow. There were shipments of iron to home ports, and, in addition, a cargo of ingot moulds for South Wales. Nothing went to the Continent last week.

Iron Ore.

Generally speaking, the trade in iron ore is dull The damping of two furnaces affects the local mines to a certain extent. As regards the Hodbarrow mines, which started again last week, the consumption is not confined to local furnaces. This very high-grade ore is in general demand, and in normal times is shipped in large quantities from Millom. Foreign ore is experiencing a quiet trade, and there were two cargoes in last week, one from Almeria and the other from Kirkenas, Varangar.

Steel.

The steel trade is dull, and the only mills working are at Barrow. The trade is poor, and there is no prospect yet of busy times. Barrow mills engaged are the rail, merchant and hoop. There is no business being done in plates either for ship or boiler, and the same remark applies to billets. The foundry is moderately engaged. The latter may develop.

Shipbuilding and Engineering.

The internal combustion engined tanker Scottish Musician, built by Vickers, Limited, has undergone her trials, and has proved most successful. She attained 10¾ knots. This vessel is the last of four built by Vickers for the same firm, and all are proving very reliable and economical. Carrying over 10,000 tons, they average over 10 knots, their daily consumption of oil for all purposes being about 10 tons. The Australian Commonwealth liner Jervis Bay is almost ready to proceed to Liverpool, and looks very spick and span in her new paint. A sister ship built at Barrow—the Hobsons Bay—by means of her specially insulated chambers, was able for the first time in history to bring to this country from the Antipodes a large consignment of Australian grapes, which found a ready market in London. The "Bays" are magnificent sea boats, and in the gales they have encountered they have given great satisfaction by the way they weathered them.

SHEFFIELD.

(From our own Correspondent.)

Moving Slowly.

SHEFFIELD trade recovery continues to be a very slow process; indeed, in some departments there is a lull, such as customarily marks the latter half of July and August in normal times. This year the break could well have been dispensed with, for in the earlier months of the summer there was quite enough involuntary holiday to satisfy everybody. In the tool trade, however, the little spurt of orders that came from Lancashire, and the American demand for certain special steels, have now quietened down. On the other hand, some firms report the receipt of some useful orders from South America and India. There is no doubt that more orders are being held back pending the settlement of the engineers' wage question, as a number of prospective buyers still cherish the hope that prices in the steel and engineering industry have not quite touched bottom. Generally speaking, however, this hope is doomed to disappointment, for in the great majority of instances firms have for some little time now been quoting prices that take into account all hoped-for reductions in production costs, whether in wages, transport or fuel. This practice was started by a few firms who were prepared to take the risk in the hope of getting some business to keep their works running, even if it could not prove really remunerative, and others were, of course, compelled to follow their example, with the result that nearly all recent reductions in costs have been already discounted before coming into operation. The prospects of the further lowering of prices are therefore very remote. Moreover, it is found that in most lines German prices are no longer very much lower than those of British manufacturers, while the uncertainty of delivery from Germany makes customers very reluctant to place orders there. Inquiries even more than actual orders are consequently of a very much more hopeful character now. At the same time the unemployment figures for Sheffield still remain extremely high; the settlement of the engineers' dispute has so far reduced the total by no more than 7000, and last week's figure was only 650 below that for the previous week. Rolling mills, forges, steel foundries and steel furnaces are all on short time, and, generally speaking, Sheffield's steel and engineering works are probably not producing more than about 50 per cent. of capacity.

Encouraging Signs.

Still, there are definite signs of an increasing demand for steel; perhaps the most significant instance is the starting up of five of the 60-ton Siemens-Martin steel furnaces at the new works of Steel, Peech and Tozer, the principal firm in the great United Steel combination. This is particularly cheering after a stoppage of something like eighteen months. The buying of raw materials required in the various Sheffield steel processes is also quickening in a manner that indicates manufacturers' confident anticipation of increased demand in the early future. A few more local firms have obtained some useful orders from Russia for files, saws and other tools, but it is said the price obtained is on a keenly competitive basis, and but for the help the work gives in keeping plant running and workmen ready for the bigger things hoped for, it would probably not have been taken by some of the firms concerned. Generally speaking, price cutting in the file trade has reached very serious limits, as indeed it was found necessary if this country was to compete with any hope against the big American makers, who have the advantage of enormous productive capacity. Attempts to compete on similar mass production lines here do not, however, seem to meet with the success anticipated.

Mr. Vickers' Views.

Considerable interest was excited by the review of the situation and future prospects made by Mr. Douglas Vickers at the annual meeting of the shareholders of Vickers Limited last week. On the whole his speech was one of reasoned and tempered optimism, though he does not seem to expect much improvement in things this year. He again expressed his belief that electrical engineering is the most hopeful branch of industry, and the experience of his company and its great associated concern, Metropolitan-Vickers, during the past year, warrants this confidence. He had to admit that new contracts are not being booked as fast as the old are completed. It is, however, common knowledge that a great many big electrical schemes are about to be launched, and this will provide plenty of work, not perhaps directly for Sheffield, as it is not primarily an important centre of the electrical industry, but it will be called on for a good deal of steel and other materials and tools required for any electrical works. On the other hand, the announcement just made by the New South Wales Government office in London that the managing director of Hadfields (Australia), Limited, has just taken back to the Commonwealth a considerable quantity of new and special machinery which will largely increase the capacity and scope of the company's Australian works, must mean that Sheffield will be called upon to send correspondingly less of its special manufactures to the Dominion, as the engineers of Australia will in future be able to obtain locally all their special steel requirements. A number of Hadfield's specialists have also gone out to Australia to take charge of the new machinery.

Fuel and Power.

Coal and coke costs are not getting any easier; in fact, for all industrial fuels the increasing demand, coupled with reduced stocks, is tending to stiffen prices slightly; slacks in particular are hardening, and as much as 12s. 6d. is being paid, though current quotations range 1s. or so lower than this figure. Manufacturers, however, have welcomed the gas company's announcement of a further reduction in charges, bringing it down, to industrial consumers of very considerable quantities, to the equivalent of 2s. 7d. per 1000 cubic feet, which is rather more than double the pre-war price. This is the third reduction the company has made in the present year. Another matter of interest and importance to local power users is the announcement that the Electricity Commissioners have now fixed the date of the postponed local inquiry concerning Sheffield Corporation's scheme for the constitution of a Joint Electricity Authority for the North-East Midlands Electricity District. The scheme provides for the extension and development of the supply of electricity in a large area in South Yorkshire, Nottinghamshire, Derbyshire and Lincolnshire. The area extends over something like 40 miles from east to west and 20 miles from north to south, and embraces an enormous number of industrial enterprises, where the total actual and potential consumption of current for power purposes must be as large as in any area of comparable size in the country. It is perhaps a significant coincidence that, simultaneously with the consideration of this scheme and of the Electricity (Supply) Bill which is before the House of Commons, there should be introduced in the House of Lords the Smoke Abatement Bill, which has, of course, a special interest to Sheffield, many of whose steel manufacturers and experts maintain that the emission of dense smoke is unavoidable in certain processes of steel making. Lord Newton and his Committee came here in the course of their inquiry a year or so ago and met with a considerable weight of adverse criticism of their proposals, though they were able to confront their critics with the experience of Pittsburg, where, they contended, the atmosphere is incomparably purer than that of Sheffield, although its industries are very similar.

Night Employment of Boys.

Another item of parliamentary news which has aroused a great deal of resentment in this district is the Home Secretary's refusal to ask the Government to sanction exceptional treatment of the Sheffield iron and steel and kindred industries from the operation of the Women, Young Persons and Children Employment Act of 1920, under which it is no longer permissible to employ lads under sixteen years of age on night work. As was recently pointed out in this column, an influential deputation of local manufacturers urged upon Sheffield members of Parliament the serious effects of this measure, seeing that something like one-third of the employees in the local steel trade are under eighteen years of age, and if lads cannot be brought into the trade before sixteen they will in the meantime enter other employment and the shortage of labour in this industry—already serious in normal times—will be accentuated. The local members passed on the representations to Mr. Shortt, whose decision was communicated to Colonel H. K. Stephenson, D.S.O., last week. One firm estimates that the additional cost to it will be not less than £12,000 per annum. Seeing that foreign competitors are not similarly handicapped, the effects on Sheffield trade are likely to be very serious.

NORTH OF ENGLAND.

(From our own Correspondent.)

A Mutual Understanding.

IT is a tribute to the foresight of iron and steel manufacturers as well as workmen that during the long period of transition there has been a mutual understanding, which has not only brought credit to employers and employed, but has set an example to every other industry—an example which, if copied, would settle many of the irksome disputes that now arise, and which prevent the smooth working of the industrial wheels. It is, indeed, a matter of congratulation that the iron and steel trade, during its long period of depression, has had no additional troubles with disputes and strikes. It is fitting, therefore, that reference should be made in these columns to the annual report of the Blast-furnacemen, Ore Miners and Coke Workers' Union. It has its pleasing as well as its distressing features, but the report is a notable contribution to the spirit of goodwill, which not only pervades the iron and steel industry as a whole, but shows that employers and employed are united in their efforts to secure an improvement in the present trade conditions. It is a record of self-sacrifice on the part of both manufacturers and workmen. The report is eloquent of this fact when it states, "the industry has shown a striking example of adjustment to violently fluctuating conditions, without the accompaniment of industrial strife. Capital and labour have both realised the tremendous difficulties of the transition period." The workers have realised the difficulties that manufacturers have faced to keep going even on a small scale, and while it is regrettable that 60 per cent. of the blast-furnacemen and allied workers are out of work, the men are the first to admit that the employers in the pig iron trade have courageously faced a desperate situation by drastic cuts in prices. Further, the men, knowing that business was being conducted at a loss, have loyally accepted the reductions involved in the sliding-scale system, and in some districts have gone even further by accepting additional reductions in anticipation of the sliding scale. These sacrifices have been made with one object—that of helping the employers to improve employment in the industry. May such spirit of goodwill between employers and employed continue in the iron and steel trade. It is for the good of both sections.

Cleveland Iron Trade.

The Cleveland iron trade possesses some disquieting features, and business is slow in recovering. Midland iron is coming into the district, though not in big quantities, while another disturbing factor is that local merchants are selling continental pig to Scotland. Otherwise there is very little new to record. No. 1 Cleveland pig and siliceous iron continue scarce and remain firm at 95s. Other grades are in good supply and easy in price. No. 3 G.M.B. was 88s.; No. 4 foundry, 87s.; No. 4 forge, 85s.; mottled and white, each 80s. per ton. All the quotations are f.o.t. makers' works or f.o.b. Tees.

Hematite Pig Iron.

Business in East Coast hematite pig iron is being affected by the plentiful supplies. Values show a downward tendency. Makers no longer demand 94s. as the minimum home quotation for Nos. 1, 2, and 3, and are prepared to accept 93s. Business, however, is not being done at that figure, buyers being content to wait. There are sellers of mixed numbers for export at 91s. No. 1 hematite was quoted 6d. to 1s. above mixed numbers.

Iron-making Materials.

There is no improvement in the business for foreign ore, and this branch of trade is practically idle. No one seems inclined to buy, and trade is in a very depressed state. Best Rubio ore remains nominally at 25s. per ton c.i.f. The trade in coke is quiet, and with prices likely to be reduced, buyers are holding off. Durham blast-furnace coke is a little stronger in price at present. For medium qualities 27s. per ton is asked, but there is a marked disinclination to pay that price.

Manufactured Iron and Steel.

The manufactured iron and steel industry lacks activity, and there are suggestions that the fixed price agreement in relation to home sales will shortly come to an end. Prices have in some instances been cut in order to counteract the attempts of French and Belgian steel makers to get a command of the market. Business all round is quiet, and trade is of the hand-to-mouth kind. The quotations remain unaltered, though, of course, it is expected that next month will see a reduction, that is, if manufacturers give buyers the benefit of the new rail freights which will then come into operation.

The Coal Trade.

The Northern coal trade is reaping the benefit of the industrial troubles in America, and the forecast given in these columns a week ago is being completely fulfilled. The trade promises to participate in an exceptional boom, but the length of it is very obscure, and, of course, all depends upon whether America is able to right her internal labour quickly. America's misfortune has served the coal trade a good purpose if it can be strictly regarded in that light. It is, nevertheless, a welcome revival in trading conditions, and producers are making the most of it. The demand for coal for shipment to America continues unabated, and both Durham and Northumberland are being scoured for all possible supplies for any date of loading up to the end of September. Any class of coal is snapped up at full current prices, and the promise of early shipment brings with it enhanced value. Valuable contracts have been placed, and it is roughly estimated that America has bought or is in negotiation for at least 300,000 tons. In addition to this, inquiries are expanding, and the position at present has unlimited possibilities. It is difficult, of course, to say how long this unexpected boom will continue, but America's anxiety to get coal cannot be denied, and she is making a frantic effort to be sure of its future for at least a couple of months. The tone of the market has stiffened considerably in consequence of the American demand. In addition, European buyers have again come into the market, and in the case of Italy and France there are negotiations to book supplies at quotations far in excess of recent prices. These countries had been holding off in the expectation of falling prices, but the advent of America has upset their calculations, and they are competing for supplies at increased prices. The general outlook for both Durham and Northumberland coals is distinctly cheerful. Gas coals are becoming short, and have moved up in price appreciably, and this applies also to almost every brand of either coking or bunkers. Steams of every class are very firm, especially in regard to best screened and best smalls, while secondary kinds are also dearer. Coke is a steady market with a good demand for patent oven, foundry or any make of gas coke. The trend of events seem to suggest a temporary period of exceptional prosperity for the coal trade as a whole.

SCOTLAND.

(From our own Correspondent.)

Holiday Markets.

THE industrial world in Scotland was almost entirely dominated by the holiday spirit during the past week. Works of all kinds were closed down, and in many instances will not reopen until Monday, the 31st. Consequently, there was little or no business done in the various markets. Prices were not tested, and no changes have so far been reported. Buyers are hopeful of easier

terms, but there seems little hope of that in the meantime at least. It is expected that the Scotch railways will fall into line with the English companies in the matter of carriage charges and thereby afford some relief to consumers.

Steel and Iron.

The works have been busy on repairs, &c., during the past few days, but only a few have sufficient business in hand to warrant a re-start early this week. These few have some good orders on hand for sectional material principally. Steel sheets, plates, and re-rolled material have little to look forward to at present. A number of shipping inquiries still come along, but the terms mentioned are not attractive. Bar iron makers havel ittle to encourage them, having made little progress since the last reduction of prices. Foundry qualities of pig iron have a small regular turnover and occasional good export orders, but hematite is exceedingly slow to move.

Foreign Materials.

Offerings of cheap continental materials, such as billets, slabs, pig iron, &c., are becoming more frequent again. Local consumers, however, have their requirements fairly well covered, and are not disposed to anticipate necessities. Consequently, few sales of continental materials are reported. Some consumers fully expect that considerably lower prices will soon prevail in the home markets, and prefer to wait until that is an accomplished fact.

Coal.

Almost nothing was done in the Scotch coal market last week, as the collieries were practically all closed for the holidays. The Clyde and Forth ports were fairly active, and a number of steamers were dispatched. From the Forth the cargoes were chiefly for German and Scandinavian destinations. The demand for washed nuts continues, but owners are averse to committing themselves until the collieries reopen. Also, the dearth of orders for round coal is a distinct drawback, the coalmasters being less inclined to sell small stuffs unless large fuels are also bought. Washed nuts are very firm in price, but in the case of round coal the quotations are very fluctuating. The turnover in household coal is poor, even although the weather conditions have been in favour of business. Aggregate shipments for the past week amounted to 181,529 tons against 301,413 tons in the preceding week, and 302,504 tons in the same week in 1913. The Scotch collieries have also received inquiries from America, but owners are not satisfied with the prices offered and apart from sending some lots to England for shipment practically nothing has been done in this direction.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Booming.

THE steam coal market has again lived up to its reputation of being quick to change. Since writing a week ago there has been quite a somersault in the conditions. At that time there were indications that the market was emerging from the gloom of utter depression, and it was recognised that there were possibilities of better conditions prevailing; but a regular boom has developed, and the only hope is that the collieries will not overdo matters and demand too high prices resulting in discouraging buyers from operating ahead. That is unfortunately too often the case. The position is that the American and Canadian demand for coal has materialised. There is a rush for prompt supplies. The collieries in many cases have filled up their books for pretty well the whole of August, and whereas a week ago best Admiralty large could be bought at 24s. to 24s. 6d., now colliery salesmen have done business at 27s. to 28s., and are declining to accept less than 30s. for any further business. When the events of the past week or so are examined, it is not surprising to find such a pronounced alteration in the market as has been the case. Reference has been made to American inquiries on more than one occasion, and the fact that the putting forward of offers has resulted in nothing coming of them, so that the market had come to be rather sceptical respecting the probability of business ever maturing. This time, however, the numerous inquiries which were circulated resulted in the offers made being accepted, and the consequence was that immediately the buying of coals and the demand for tonnage to lift the supplies became very heavy. There were one or two firms which got into a definite position with their business before the general rush and took advantage of the fact to secure their tonnage for the North American range of ports at 7s. 6d. free discharge; but when it was found that subsequently almost every other firm at the docks had an order the freight market began to move until the latest rate of freight at which tonnage has been chartered is 12s. 6d., free discharge. Whether the firms which have the business ever calculated that they would have to pay such a rate as this is to be doubted, but as the coals have to be shipped pretty quickly it looks as if they have no choice but to take the most suitable boats available at the best rate they can be obtained at. It is reported that American tonnage is coming across to assist to lift the coals that are required, but this must take some time. So far it is estimated that tonnage has been chartered to lift a quarter of a million tons of coal from this district, and that in the course of a week the quantity will have increased to 300,000 to 400,000 tons. At the moment of writing it is reckoned that there are still twenty to twenty-five orders in the market for steamers for the North American range of ports and for Canadian ports.

Dislocation of Business.

The sharp influx of American business has, comparatively speaking, paralysed operations for other directions temporarily. The collieries are doing well, and the shipowners are getting a look in as freight rates are moving upward, but the exporter is experiencing a very difficult time. The exporter is the middleman who takes the risk of making c.i.f. offers, and those who had made such offers before the American invasion are now feeling the breeze unless they had covered for the coals; but in any case the freight market has gone against them to the extent of anything probably from 1s. to 2s. per ton. The bulk of the tonnage of a fair size is being worked for the American requirements, with the result that it is very difficult to obtain steamers for orders for the Mediterranean and Far East destinations. The whole outlook has altered and everyone has been compelled to revise their estimates regarding future operations. There is no doubt that many exporters have business already on their books which they cannot carry out except at a considerable loss owing to the different complexion which has come over trading conditions, and as regards fresh inquiries which are coming along, they are in a quandary what to do because of the extreme uncertainty as to the risks involved. Inquiries are arriving pretty freely from France, Italy, and other Mediterranean places from consumers who are anxious to get in for supplies owing to the rise in prices and the fear that values of coal will go still higher; but sellers can scarcely tell on what figures to base, and are reluctant to make any firm offers, as collieries will not quote ahead, and it is impossible to say what freight rates will be like in a few weeks time. There is this to be said, that shipowners will come to see that even at 12s. 6d. or perhaps more there is not much in the American business as homeward business will be difficult to get for all the tonnage that has already been fixed for that direction, and it will mean for many boats a ballast run back, so that tonnage will in time gradually become more interested in Mediterranean orders, and the markets will become more settled, but this will take time.

Coal Railway Rates.

Mr. Finlay Gibson, the secretary of the South Wales Coalowners' Association, states that considerable misapprehension appears to have arisen as to whether the coal trade is bound by the recent agreement entered into by the Federation of British Industries and the Associated Chambers of Commerce with the railway companies, in reference to the reductions granted by the latter, to operate as and from August 1st for a period of one year. The Mining Association of Great Britain has already announced that the coalowners of the country were not parties to the agreement referred to, neither had the Federation of British Industries any authority on behalf of or to commit the colliery owners. The latter, therefore, are free to continue their negotiations with the railway companies if they so desire for further reductions, or to appeal to the Rates Tribunal on any rates which relate to colliery working. The question of the reductions recently conceded by the railway companies will be considered by the Commercial Committee of the Coalowners' Association at a meeting this week, when a decision will be arrived at as to what, if any, further action shall be taken.

Tin-plate and Steel Wages.

The auditors jointly appointed by the Siemens steel employers, the tin-plate manufacturers, and the unions to which the workmen are connected, to ascertain the selling price of Siemens steel tin bars for the purpose of fixing wages, report that the price of tin bars f.o.b. for the months of April, May and June was £7 2s. 4d. per ton. This is an advance on the price for the months of January, February and March, which was £7 1s. 10½d. The price, however, is still below zero in the case of Siemens steel workers, which is £7 5s. per ton, and £7 10s. in the case of the tin-plate workers, so that a considerable advance is still required before the sliding scale in either case becomes operative.

Current Business.

The steam coal market is firm all round, and at the moment it is rather difficult to say exactly what prices are, as so far this week prices have been altering almost hourly until now they are on the basis of 30s. for the best Admiralty large and about 28s. for second qualities. Superior Monmouthshire large are quoted at 27s. 6d., and may go even higher, while small coals are strong. Best smalls are 20s., but even ordinary cargo sorts have been done at 19s. 6d. and 19s. 9d., so that the tip-top qualities are likely to go over 20s. before long. Patent fuel is firmer at 25s. to 27s. 6d., and coke is also in demand, and although 36s. to 37s. 6d. has been indicated for supplies, sellers are now looking for higher values, and it will not be surprising if the price advances well over 40s. Among the inquiries on the market is one of 10,000 tons of Cardiff-Newport small coals from the French State Railways for shipment within a month from the conclusion of the business, for which tenders have to be in on Monday next. It is noteworthy that so far none of the miners' leaders has raised the question of the miners stopping work seeing that the coals for America are obviously to break the strike of miners in that country. It is doubtful whether the issue dare be raised seeing that what the workmen in the South Wales coalfield want is work, and they are now likely to get it for some weeks at least. The prospect of regular work being maintained for some time is having the effect of stimulating the demand for pit-wood, and the consequence is that the price for this commodity has advanced from 24s. to 35s. for prompt deliveries.

Latest News from the Provinces.

WALES AND ADJOINING COUNTIES.

Miners' Holidays.

THE official holidays for the miners will be three days, viz., from August 7th to 9th inclusive.

Coal Market.

Although slightly quieter, the tone of the market is still firm, with best Admiralty large at 30s., while smalls have been done at 21s. Outward freight rates are firm, and 13s. has been paid for tonnage for the United States.

Railway Rates.

The Commercial Committee of the South Wales Coalowners' Association has considered the recently announced reductions in railway rates on coal, &c., and has entered its emphatic protest against their inadequacy. It urges that as regards coal the percentage of 75 should be reduced to 50, and that the flat rate should be totally abolished. The Committee requests the Great Western Railway Company immediately to grant further reductions in the rates on coal and pitwood, and to receive a deputation forthwith.

ACCIDENT WITH AN ELECTRIC LAMP.

ONE of the fatalities referred to in the recently issued report on electrical accidents in factories was caused by the use of the screw-socket type of lampholder, a very old type of holder, but not until recently much used in this country. When used with lamps fitted with screw caps which entirely entered the screw socket, there was no objection. Recently, however, lamps, both of small and large sizes, have been made with a metal extension of the screw cap in the form of a cup covering the neck of the lamp and extending far outside the screw socket of the holder. It is often overlooked that this exposed extension of the screw cap is in electrical connection with the circuit, is live, and that it may be dangerous to touch it. In the case in question a man, attempting to remove a lamp from the holder, took hold of the metal cup and was killed. The single pole switch controlling the circuit was connected in the earthed neutral lead instead of in the phase wire of the circuit, so that even had the switch been off it would not have prevented the accident. It appears that for lamps of small size there is no need for this cup extension of the screw cap, but for large size lamps it is necessary for the secure attachment of the lamp. The use of the metal extension is not in accordance with the regulations unless the lamp is used with a holder or fitting which will entirely screen the live cap so that it cannot be touched whilst in contact with the circuit. Lamp holders for use with these lamps should be provided with a petticoat extension of insulating material to shield the live metal, or preferably an extension of the screw cap should be made of insulating material.

LAUNCHES AND TRIAL TRIPS.

HOPPER BARGE No. 24; built by the Monmouth Shipbuilding Company, Limited, to the order of the Port of London Authority; dimensions, length B.P. 215ft., breadth moulded 35ft. 6in., and depth moulded 19ft. 3in.; hopper capacity 1000 cubic yards. Engines constructed by the Fairfield Shipbuilding and Engineering Company, Limited; trial trip, July 19th; 10¼ knots.

MODJOKERTO, geared turbine steamer; built by Wm. Gray and Co. (1918), Limited, of Sunderland, to the order of Messrs. Ruys and Zonen, of Rotterdam; dimensions, 451ft., 57ft. and 32ft. 10in. moulded to upper deck; to carry about 11,600 tons deadweight. Engines, one high-pressure impulse turbine and one low-pressure reaction turbine independently connected through flexible couplings to a set of double-reduction gear wheels; astern turbines contained in the ahead casings; pressure 225 lb. per square inch, 100 deg. superheat; constructed by the Central Marine Engine Works; trial trip, July 20th.

NALGORA, geared turbine steamer; built by Wm. Gray and Co. (1918), Limited, of Sunderland, to the order of the British India Steam Navigation Company, Limited; dimensions, 451ft., 57ft., depth moulded to upper deck 32ft. 10in.; to carry about 11,600 tons deadweight. Engines, single-screw double reduction geared turbines of Parsons type, pressure 225 lb.; constructed at the Central Marine Engine Works of the builders; trial trip, July 25th.

BARGE No. 25, steel screw hopper type; built by the Monmouth Shipbuilding Company, Limited, of Chepstow, to the order of the Port of London Authority; dimensions, length B.P. 215ft., breadth moulded 35ft. 6in., depth moulded 19ft. 3in., mean draught 16ft.; to carry 1000 cubic yards of dredgings. Engines, triple-expansion condensing, pressure 180 lb. per square inch; constructed by the Fairfield Shipbuilding and Engineering Company, Limited; launch, July 26th.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

AT the meeting of the Electric Vehicle Committee of Great Britain, held at the Institution of Electrical Engineers on the 13th inst., Mr. J. A. Priestley, cleansing superintendent of the Sheffield Corporation, was elected chairman of the Committee, and Mr. W. H. L. Watson, of Electricars, Limited, and Mr. W. Worby Beaumont were elected vice-chairmen. Mr. E. E. Hoadley was re-elected hon. secretary, and Mr. J. Christie hon. treasurer.

EDGAR ALLEN AND CO., Limited, of Sheffield, inform us that they have changed the brand on their air hardening high-speed steel, containing 14 per cent. of tungsten, adding to the existing description of "Air-hardening" the figure of a stag and the words "Stag Brand."

MARTIN BROS. (MACHINERY), Limited, of 33-35, Bridge-street, Manchester, inform us that Mr. Alex. W. Maycock has joined their staff in the capacity of manager, covering the machine tools, woodworking machinery and power transmission plant departments.

CONTRACTS.—Palmers, Shipbuilding and Iron Company, Limited, has received an order for a set of triple-expansion engines for an oil tanker.

CRYSTAL PALACE SCHOOL OF ENGINEERING.—Major-General Sir G. K. Scott Moncrieff presided on Wednesday at the summer term certificate distribution of the Crystal Palace School of Engineering. The school's certificate of honour was awarded to Mr. W. H. Butler. Sir Scott Moncrieff said one of the great attractions of the engineering profession was that it was continually progressive. It was a profession of achievement. He knew of no greater source of gratification than in seeing in use work completed from designs from one's own brain, the triumph of mind over matter. Sir Scott then gave the students some practical suggestions gained by him in his wide experience and coming under the five heads—planning, materials, structural design, works method, and counting the cost.

Current Prices for Metals and Fuels.

IRON ORE.

N W. COAST—	
Native	25/-
(1) Spanish	25/-
(1) N. African	25/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	25/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	5 8 9	—
No. 1 Foundry	5 0 0	—
No. 3 Foundry	15 0	—
N.E. COAST—		
Hematite Mixed Nos.	4 13 0	4 11 0
No. 1	4 14 0	4 12 0
Cleveland—		
No. 1	4 15 0	4 15 0
Silicious Iron	4 15 0	4 15 0
No. 3 G.M.B.	4 8 0	4 8 0
No. 4 Foundry	4 7 0	4 7 0
No. 4 Forge	4 5 0	4 5 0
Mottled	4 0 0	4 0 0
White	4 0 0	4 0 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
Part Mine Forge	*None offering.*	
North Staffs. No. 3 F'dry	4 5 0 to 4 10 0	
(3) Northampton—		
Foundry Nos. 2 and 1	*Nominal.*	
,, No. 3	4 0 0	—
,, Forge	3 10 0 to 3 12 6	
(3) Derbyshire—		
No. 3 Foundry	4 0 0 to 4 2 6	
Forge	3 12 6 to 3 15 0	
(3) Lincolnshire—		
Basic	4 0 0 to 4 5 0	
Foundry	4 5 0 to 4 10 0	
Forge	4 2 6 to 4 5 0	
(4) N.W. COAST—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	5 10 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 10 0	10 10 0
Best ,,	12 0 0	—
N.E. COAST—		
Crown Bars	12 0 0	—
Tees	10 10 0	—
LANCS.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	13 15 0
S. YORKS.—		
Crown Bars	12 0 0	—
Best ,,	13 0 0	—
Hoops	14 0 0	—
MIDLANDS—		
Crown Bars	11 0 0	—
Marked Bars (Staffs)	13 10 0	—
Nut and Bolts Bars	10 0 0	—
Gas Tube Strip	11 0 0 to 11 5 0	
Hoops (Nom.)	14 0 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	13 10 0	—
Ship Plates ⅜in. and up	10 0 0	—
Sections	9 10 0	—
Steel Sheets ¼in. to ⅛in.	11 5 0	—
Sheets (Gal. Cor. 24 B.G.)	—	15 10 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 0 0	9 0 0
Angles	9 10 0	—
Boiler Plates	13 10 0	—
Joists	10 0 0	8 10 0
Heavy Rails	9 10 0	—
Fish-plates	14 10 0	—
Channels	14 10 0	—
Hard Billets	8 15 0	—
Soft Billets	7 15 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 10 0	—
Light ,,	11 0 0 to 13 0 0	
Billets	9 5 0	—
Ship Plates	10 0 0	—
Boiler ,,	13 10 0	—
MANCHESTER—		
Bars (Round)	9 10 0 to 11 10 0	
,, (others)	10 10 0 to 11 10 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	9 10 0 to 11 0 0	
,, (Lancs. Boil'r)	15 10 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Bessemer Billets	12 10 0	—
Hard Basic	8 15 0	—
Soft ,,	7 10 0 to 7 15 0	
Hoops	12 5 0	—
Soft Wire Rods	11 0 0	—
MIDLANDS—		
Small Rolled Bars	9 5 0 to 9 10 0	
Bessemer Billets	7 10 0	—
Hoops	11 10 0 to 12 0 0	
Gas Tube Strip	10 5 0 to 10 10 0	
Sheets (24 W.G.)	12 0 0	—
Galv. Sheets (f.o.b. L'pool)	15 10 0	—
Angles	9 10 0	—
Joists	10 0 0	—
Tees	10 10 0	—
Bridge and Tank Plates	10 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/6 to 19/9
Block Tin (cash)	158 5 0
,, (three months)	158 7 6
Copper (cash)	63 7 6
,, (three months)	63 12 6
Spanish Lead (cash)	25 12 6
,, (three months)	24 2 6
Spelter (cash)	29 12 6
,, (three months)	29 7 6
MANCHESTER—	
Copper, Best Selected Ingots	69 0 0
,, Electrolytic	71 10 0
,, Strong Sheets	94 0 0
,, Loco Tubes	0 1 1½
Brass Loco Tubes	0 0 11½
,, Condenser	0 1 2½
Lead, English	27 0 0
,, Foreign	25 15 0

FERRO ALLOYS.

(All prices are nominal.)

Tungsten Metal Powder	1/8 per lb.
Ferro Tungsten	1/5 per lb.

	Per Ton.	Per Unit
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£27	10/-
,, 6 p.c. to 8 p.c. ,,	£25 10 0	9/-
,, 8 p.c. to 10 p.c. ,,	£24 10 0	8/-
,, Specially Refined		
Max. 2 p.c. carbon	£65	26/-
,, 1 p.c. ,,	£80	30/-
,, 0·75 p.c. carbon	£85	37/-
,, carbon free	1/1 per lb.	
Metallic Chromium	5/3 per lb.	
Ferro Manganese (per ton)	£15 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£13 0 0 scale unit	5/- per
,, ,, 75 p.c.	24 10 0 sca'e unit	6/- per
,, Vanadium	18/- per lb.	
,, Molybdenum	6/6 per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£160	
Cobalt	11/- per lb	
Aluminium (per ton)	£110 to £120 (British Official.)	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	20/6
,, ,, Ell	22/6
,, ,, Splint	21/- to 24/-
,, ,, Trebles	21/-
,, ,, Doubles	20/-
,, ,, Singles	19/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	20/6
,, ,, Splint	22/-
,, ,, Trebles	21/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	19/- to 22/6
Screened Navigation	27/-
Trebles	21/6
Doubles	20/6
Singles	19/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	21/6
Secondary Steam	20/6
Trebles	21/6
Doubles	20/6
Singles	19/6

ENGLAND.

(8) N.W. COAST—	
Steams	33/-
Household	46/8 to 57/6
Coke	34/-
NORTHUMBERLAND—	
Best Steams	24/ to 25/-
Second Steams	22/- to 22/6
Steam Smalls	16/- to 17/6
Unscreened	20/6
Household	25/- to 28/-
DURHAM—	
Best Gas	22/6 to 25/-
Second	21/6 to 22/6
Household	25/- to 28/-
Foundry Coke	33/- to 35/-

SHEFFIELD—	Inland.	Export.
S. Yorks. Best Steam Hards	21/- to 22/-	—
Derbyshire Hards	20/- to 21/-	—
Seconds	18/- to 20/-	—
Cobbles	17/- to 19/-	—
Nuts	16/- to 18/-	—
Washed Smalls	15/- to 11/-	—
Best Hard Slacks	12/- to 13/-	—
Seconds ,,	9/- to 10/6	—
Soft Nutty ,,	7/6 to 8/6	—
Pea ,,	7/- to 8/-	—
Small ,,	2/- to 4/6	—
House, Branch	30/- to 33/-	—
,, Best Silkstone	27/6 to 29/-	—
Blast Furnace Coke (Inland and Export)	19/- to 21/-	

(9) SOUTH WALES.

CARDIFF— Steam Coals:	
Best Smokeless Large	29/- to 30/-
Second ,, ,,	27/6 to 28/-
Best Dry Large	26/6 to 27/-
Ordinary Dry Large	25/- to 26/-
Best Black Vein Large	27/- to 28/-
Western Valley ,,	2[illegible]/6 to 27/6
Best Eastern Valley Large	26/6 to 27/6
Ordinary ,, ,,	24/- to 25/-
Best Steam Smalls	20/- to 21/-
Ordinary ,,	18/- to 19/-
Washed Nuts	23/6 to 24/6
No. 3 Rhondda Large	27/6 to 28/6
,, ,, Smalls	19/- to 20/-
No. 2 ,, Large	23/6 to 24/6
,, ,, Through	20/- to 22/-
,, ,, Smalls	15/- to 16/-
Coke (export)	37/6 to 40/-
Patent Fuel	25/- to 28/6
Pitwood (ex ship)	33/6 to 35/-
SWANSEA— Anthracite Coals:	
Best Large	52/6 to 55/-
Seconds	40/- to 45/-
Red Vein	30/- to 32/6
Big Vein	42/6 to 47/6
Machine-made Cobbles	62/6 to 65/-
Nuts	60/- to 65/-
Beans	37/6 to 42/6
Peas	23/- to 25/-
Breaker Duff	7/6 to 8/-
Rubbly Culm	14/- to 14/6
Steam Coals:	
Large	21/- to 23/-
Seconds	20/- to 21/-
Smalls	14/- to 15/-
Cargo Through	18/- to 20/-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England

(7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b for export.

(9) Per ton f.o.b.

NOTE.—Coal prices for export are still rising.

French Engineering Notes.

(From our Correspondent in Paris.)

Reconstruction.

THE putting into operation last week of the Wiesbaden arrangement for the partial payment in goods of the amount due from Germany for reparations is generally regarded in the light of an experiment, but there are difficulties in the way that may for the time being interfere with its satisfactory application. So far as concerns the material, machinery and plant which are to be supplied by German firms and paid for by the German Government, the trouble arises from the insistence of the Minister of the Liberated Regions to have those goods imported under the minimum tariff, while the Government Departments, representing industrial interests, claim that the material should be imported under the full tariff, so that the prices would approximate to those of similar goods manufactured in France. Otherwise, it is urged that the French industry will be seriously threatened, while opportunities will be afforded for speculation in German products. Again, it is claimed that if the arrangement for supplying German material and machinery, which will be paid for by the German Government in reduction of the reparation, is put in hand before the clauses under which Germany is to replace machinery and other goods removed during the war are finally sanctioned, there is a risk of those clauses becoming inoperative. They are temporarily held up by the refusal of Belgium to approve of them so far as they relate to the supply of coal. There is a belief in many quarters that the carrying out of work in the devastated regions with the aid of material supplied by Germany will have a satisfactory repercussion on trade generally, since it will largely increase production and help to bring down prices, which may be followed by a reduction of the present high wages and a diminution of living cost. On the whole, the Wiesbaden arrangement is being favourably received. While preference will be given to material for the devastated regions, where it will be credited against the demands for indemnities from those who suffered from the destruction of property, it will also be possible for manufacturers and others outside those districts to purchase German machinery, the value being paid to the French Government on account of reparations. The arrangement also prepares the way for the carrying out of the big programme of public works which M. Le Trocquer has presented to the Commission of Reparations, under which Germany is to supply the greater part of the material and labour.

Pulverised Coal.

One of the problems that have always confronted the colliery companies has been the most suitable way of utilising the slack which, on account of the friable nature of the coal, accumulates in considerable quantities at the pits. The manufacture of briquettes has permitted of the slack being converted into a useful fuel for transport, but there is obviously no necessity to employ briquettes for steam raising at the collieries if the coal can be injected more economically into the grates in a pulverised form. The first results were obtained at the Mines de Bruay, in the Nord, where the electrical generating plants were equipped with apparatus for injecting pulverised coal into the boiler furnaces, when it was stated that an economy of 30 per cent. was realised over the consumption of solid fuel. Equally satisfactory results appear to have been obtained at the Montceau-les-Mines colliery of the Société des Mines de Houille de Blanzy, where an American system, adapted by French engineers, is employed. The slack is reduced in a Raymond pulveriser, and the dust is fed by automatic distributors to two burners under a Babcock and Willcox generator, having 2368 square feet of heating surface. Tests carried out continuously for 704 hours showed an average evaporation per kilogramme of fuel was 6.75 kilos. of water. In view of these satisfactory results, it is understood that the colliery companies intend to employ pulverised coal on a large scale for steam raising.

Paris Metropolitan.

The Metropolitan Commission has presented to the Paris Municipal Council a report upon the permanent works to be carried out in connection with the Metropolitan Railway extensions, of a length of nearly 32 kiloms., which will bring the total length of the system up to 137 kiloms. The cost of the new permanent works, comprising mainly tunnels, viaducts and stations, is estimated at 420 million francs. The amount will be raised by a public loan. The Municipal Council does all the tunnelling and bridge-building work, and the permanent way is laid by the Metropolitan Railway Company, which hands over a percentage of the receipts to the town during the time the company holds the concession.

Trade Returns.

The returns of foreign trade during the first six months of the year do not give an accurate comparison with the business done the previous year, for the reason that the export values were based upon the lower scale fixed by the Commission in 1921, and the imports were valued by the declarations of importers, verified by the Customs. According to those values, the imports during the first half of the year totalled 10,672 million francs, a diminution of 23 million francs, and the exports 9369 million francs, a decrease of 700 million francs. Taking the weights, the imports amounted to 24,444,676 tons, of which 21,361,159 tons were raw material, which accounted for nearly the whole of the increase of 6,944,274 tons. The weight of exports was 9,777,263 tons, including 6,170,554 tons of raw material and 1,030,774 tons of manufactured goods. The total increase was 1,860,836 tons.

The Engineering Strike.

After being out on strike for nearly ten weeks against a reduction in wages, the operatives in the engineering industries in the Lille district have returned to work in accordance with the decision of an arbitration committee which has decided that any question of reduction is to remain in abeyance until November next, when the matter will be again submitted to arbitration.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

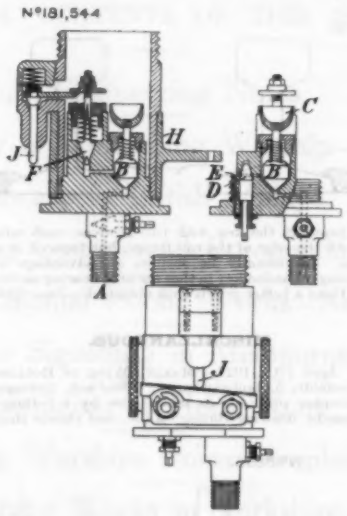
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

181,544. April 9th, 1921.—CARBURETTERS, A. Saunders, 358, High-street, Rochester.

No float is used in connection with this carburetter. The fuel enters at A, passes an adjusting valve and arrives below the valve B. The stem of this valve has a disc or cup C which is acted on by the draught of air caused by the suction of the engine, and is thus raised according to the speed of the engine.

N°181,544



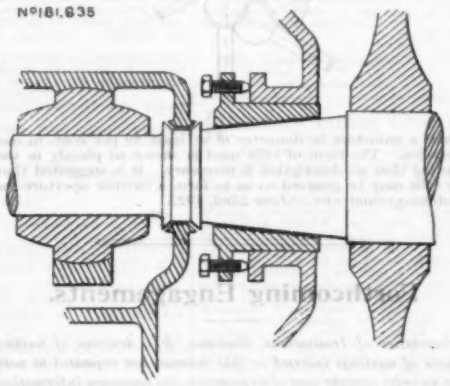
Some of the fuel passes by the passage and adjusting plug D to the slow-running jet E, while the remainder goes to the main jet, which is controlled by the valve F. The stem of this valve has grooves for the egress of the fuel. The amount of air admitted to the carburetter is regulated by the sleeve H, on which a cam race is fitted to act in conjunction with the finger J and thus open the main valve to correspond with the air inlet openings.—*June 22nd*, 1922.

TURBINE MACHINERY.

181,635. August 9th, 1921.—LABYRINTH PACKINGS, The British Thomson-Houston Company, Limited, 83, Cannon-street, London, E.C. 4, and R. F. Halliwell, 35, Leam-terrace, Leamington Spa.

In order to provide a means of taking up any accidental wear

N°181,635



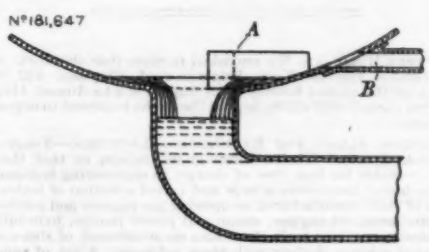
of the edges of labyrinth packings on turbine shafts the inventors make the shaft and packing tapered as shown, so that axial adjustment will regulate the clearance between the packing and shaft.—*June 22nd*, 1922.

CONDENSERS AND FEED-WATER HEATERS.

181,647. October 14th, 1921.—OUTLETS FROM CONDENSERS, G. and J. Weir, Limited, Cathcart, Glasgow, and the Right Hon. W. Douglas.

The inventors state that when the outlet for the condensate from a condenser leaves in a vertical direction a free vortex is

N°181,647



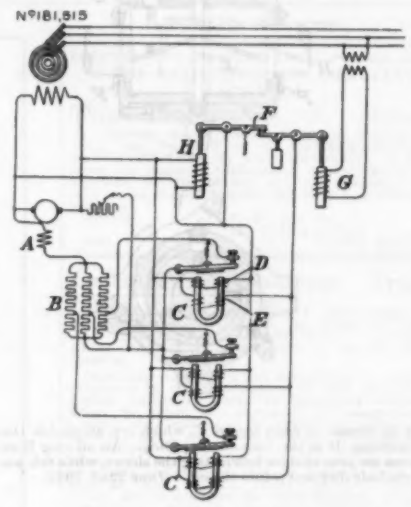
formed in the water, with the result that the water may accumulate in the condenser to such an extent as to drown the air outlet. They therefore arrange a vertical plate A above the outlet, with the idea of checking the formation of the vortex and thus permitting the lowering of the air outlet B.—*June 22nd*, 1922.

SWITCHGEAR.

181,515. March 24th, 1921.—INTERMITTENT REGULATORS, *The British Thomson-Houston Company, Limited*, 83, *Cannon-street, London, E.C.* 4.

This regulator is intended for generators having such large exciting currents that one instrument could not handle the current without excessive arcing. The exciter field circuit A is arranged in series with several parallel resistances B. Part of each of these resistances is shunted through the relays C C C.

N°181,515

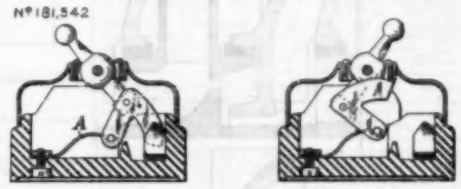


The relays have windings D connected directly across the exciter terminals and differential windings E, which are also connected across the exciter when the contacts F of the regulator are closed. The relative position of the contacts F is controlled by the line voltage acting on the solenoid G, while the solenoid H vibrates the contacts. It will be observed that the relay contacts have each to carry only a comparatively small current. The same general principle is applicable to the speed regulation of motors. —*June 22nd*, 1922.

181,542. April 8th, 1921.—A TUMBLER SWITCH, G. H. Webb, 109A, Bissell-street, Birmingham, and W. H. Wood.

This specification covers a very simple form of tumbler switch,

N°181,542

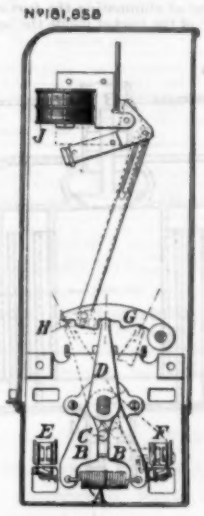


the construction of which is fairly obvious in the drawings. It will be noticed that the spring A tends to keep the switch opened or closed according to the position into which the handle is moved.—*June 22nd*, 1922.

181,658. January 3rd, 1922.—MOTOR CONTROLLERS, *The British Thomson-Houston Company, Limited*, 83, *Cannon-street, London, E.C.* 4.

This switch is intended for use in connection with compensators and has a bias towards the off position, shown by the full lines. This bias is produced by the spring A drawing together the two yokes B B that bear against the pin C on an

N°181,658



extension of the switch arm D. The starting contacts are indicated at E and those for running conditions at F. A latch G engages with the outer end of the switch arm D and is so formed that the arm cannot be moved to the running position without first having gone through the starting position, while both movements must be done smartly or the arm will be held. The arm is also held in the running position by the notch H in the latch G, but if the flow of current round the coil fails J its armature drops,

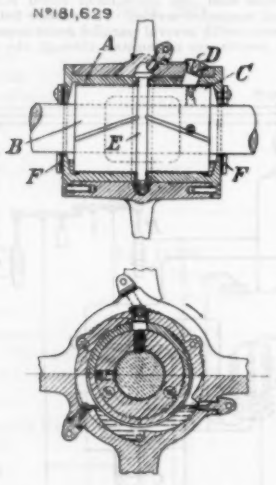
the latch is raised and the switch arm is brought to the off position by the spring A.—*June 22nd*, 1922.

TRANSMISSION OF POWER.

181,629. July 26th, 1921.—LOOSE PULLEYS, T. T. Hindle, Eden View, Eckersley-road, Bolton.

These loose pulleys are bushed, as shown at A, and are mounted on a sleeve B on the shaft. The sleeve is fixed on the

N°181,629



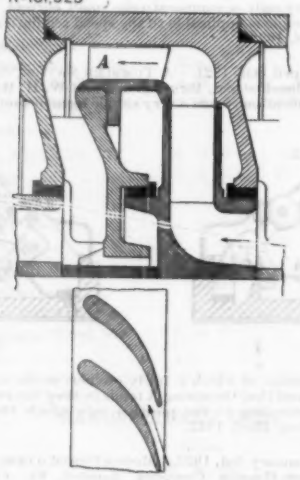
shaft by means of grub screws C, which are accessible through the openings D in the boss of the pulley. An oil ring E and oil grooves are provided for lubricating the sleeve, while felt washers F F exclude dirt and retain the oil.—*June 22nd*, 1922.

PUMPING AND BLOWING MACHINERY.

181,525. April 1st, 1921.—MULTI-STAGE CENTRIFUGAL PUMPS, *W. H. Simms*, 14 *and* 15, *Conduit-street, London, W.* 1.

With the idea of reducing the overall dimensions of multi-

N°181,525

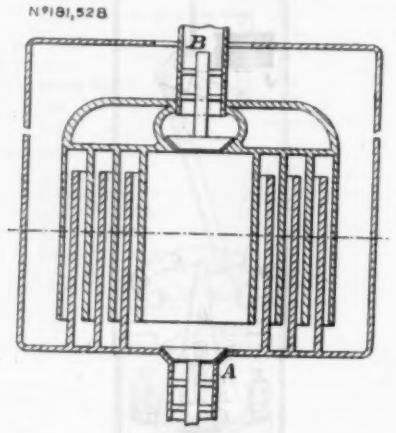


stage centrifugal pumps the inventor arranges the guide blades between the successive stages in axial passages as shown at A, instead of in the usual radial passages.—*June 22nd*, 1922.

181,528. April 2nd, 1921.—RECIPROCATING PUMPS, T. G. Pendrigh, 8, St. Kilda-road, West Ealing.

The inventor aims at eliminating the friction caused by the rubbing, in a pump, of the bucket inside the barrel by using the

N°181,528



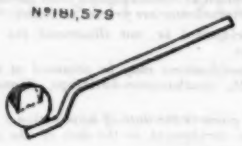
labyrinth packing indicated in the drawing. Both fixed and moving parts comprise a series of intermeshing concentric rings, which are as close together as is possible without contact. The inlet valve is shown at A and the delivery at B.—*June 22nd*, 1922.

MEASURING AND TESTING INSTRUMENTS.

181,579. May 17th, 1921.—FILAMENT SUSPENSIONS, G. C. Boulitte, 15-21, Rue Bobillot, Paris.

In this specification the inventor comments on the difficulty experienced in soldering the fine filaments used for galvanometer suspensions and similar services to their supports, and suggests that the supports should terminate in a bead of soft metal such as lead. A groove is cut in the bead, in which the

N°181,579



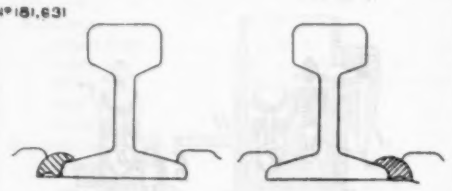
filament is then laid and the groove is closed up by pressure so that the filament is firmly gripped.—*June 22nd*, 1922.

TRAMWAYS AND RAILWAYS.

181,631. July 30th, 1921.—KEYS FOR FLAT-FOOTED RAILS, *G. H. Cowen, Westwood House, Brocco Bank, Sheffield.*

In order to make the keys used to secure flat-footed rails to metal sleepers available for right-hand or left-hand service the

N°181,631



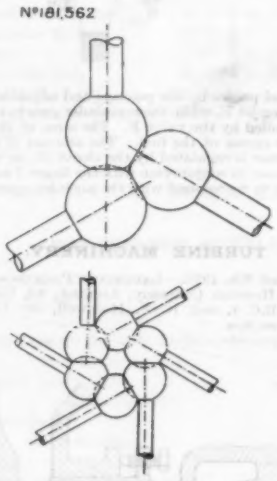
inventor provides the key with two grooves, each adapted to engage with the edge of the rail flange, but tapered in opposite directions. Incidentally he secures an advantage over the ordinary single-handed key in that the area bearing on the sleeper is reduced and a better grip is thus obtained.—*June 22nd*, 1922.

MISCELLANEOUS.

181,562. April 27th, 1921.—MAKING WIRE BY ROLLING, C. A. Achterfeldt, 5, Ludwigstrasse, Offenbach, Germany.

The inventor proposes to make wire by a rolling process rather than by drawing through a die, and claims that he can

N°181,562



secure a reduction in diameter of at least 60 per cent. in one operation. The form of rolls used is shown so plainly in the drawing that no description is necessary. It is suggested that the rolls may be grooved so as to form a circular aperture for producing round wire.—*June 22nd*, 1922.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TUESDAY TO FRIDAY, SEPTEMBER 5TH TO 8TH.

IRON AND STEEL INSTITUTE.—Autumn meeting at York. For programme *see* page 96.

WEDNESDAY TO FRIDAY, SEPTEMBER 20TH TO 22ND.

THE INSTITUTE OF METALS.—Swansea. Annual autumn meeting.

SUMMER HOLIDAY.—We are asked to state that the works of the London Electric Firm, Brighton-road, Croydon, will be closed for the annual holiday from August 4th to August 14th, but that a small staff will be kept at the works to attend to urgent business.

LANTERN SLIDES FOR ENGINEERING LECTURES.—Tangyes Limited, Cornwall Works, Birmingham, inform us that they have available for loan (free of charge) to engineering lecturers and technical instructors a large and varied selection of lantern slides of their manufactures, comprising gas engines and suction gas producers, oil engines, steam and power pumps, hydraulic machinery, machine tools, &c.; also an assortment of slides of historical interest dealing with these subjects. A list of same will be sent free on application. Messrs. Tangyes have also prepared a number of papers dealing with their different classes of machinery, which are available for loan, if required, to assist lecturers in preparing their own papers.

Catalogues.

HIGGS BROS., Sandpits, Birmingham.—A copy of the firm's monthly magazine.

JOHNSON AND PHILLIPS, Limited, Charlton, S.E. 7.—A new catalogue describing the firm's insulators.

PLENTY AND SON, Limited, King's-road, Newbury.—Copy of this company's monthly magazine *Oil Power*.

K. HOLST AND CO., Westminster Chambers, 1, Victoria-street, S.W. 1.—Brochure on ferro-concrete work carried out by the firm.

THE COVENTRY CHAIN COMPANY, Limited, Coventry.—List C22 on the "Coventry" high-precision, high-duty transmission chains.

JOHN JARDINE, Limited, Deering-street, Nottingham.—Sheet 71, B. Dept., illustrates and describes the firm's new cast iron split pulleys.

THE HARDINGE COMPANY, 11, Southampton-row, W.C. 1.—Catalogue No. 12, discussing the subject of powdered fuel, its preparation and application.

ELECTRIC CONTROL, Limited, Hastings House, Norfolk-street, Strand, W.C. 2.—Pamphlet on S. and C. extra high-tension fuses up to 115,000 volts.

BRUNTON BROS., Limited, 17, St. Stephen's House, S.W. 1.—New catalogue of the Brunton patented hydraulic system of operating water-tight bulkhead doors.

THE BRITISH REINFORCED CONCRETE ENGINEERING COMPANY, Limited, Iddesleigh House, Caxton-street, Westminster, S.W. 1.—July issue of "The Roadmaker."

HARRIS AND SHELDON, Limited, 46, Cannon-street, E.C. 4, and Hadley Castle Works, Wellington, Shropshire.—A card describing Sankey-Sheldon steel office furniture.

THE AUTOMATIC AND ELECTRIC FURNACES, Limited, 281-283, Gray's Inn-road, London, W.C. 1.—Catalogue of Wild-Barfield automatic electric furnaces for the hardening of steel.

ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE CHARLEROI, 56, Victoria-street, S.W. 1.—A copy of the firm's monthly list of motors and dynamos in stock available for disposal.

THE FERRO-ARC WELDING COMPANY, Limited, 12, Grosvenor-gardens, S.W. 1.—A small brochure on the characteristics of cast iron and the welding problems which are associated with it.

THE ELECTROLYTIC APPARATUS AND BATTERY COMPANY, Ockford Works, Ockford Corner, Godalming, Surrey.—Revised list No. 4 of Niblett's electrolysers. Leaflet on Lithos secondary cells.

THE BRITISH INSULATED AND HELSBY CABLES, Limited, Prescot, Lancs.—A copy of pamphlet No. H98, describing and illustrating the Helsby condensers for the improvement of power factor.

THE HORSELEY BRIDGE AND ENGINEERING COMPANY, Limited, Tipton, Staffs.—A pamphlet has just been issued by this firm as a souvenir of a century of progress. A brief history of the firm is given.

LOBNITZ AND CO., Limited, Renfrew, Scotland.—Bulletin No. 502, on suction dredgers. Illustrations are given of a large sea-going hydraulic dredger and a view of a shore discharge plant in operation.

THE ENGLISH ELECTRIC COMPANY, Limited, Queen's House, Kingsway, W.C. 2.—Publication No. 365, of June, 1922, illustrates and briefly describes the "Seower" governing device for impulse turbines.

COLE, MARCHENT AND MORLEY, Limited, Bradford.—Two pamphlets, Nos. 69 and 70, the first dealing with the C.M. and M. central exhaust steam engines, and the other with the products and plant of the firm.

A. A. JONES AND SHIPMAN, Limited, Leicester.—Pamphlet of manufacturers' drilling machines. Illustrations and specifications of and instructions for working the different types manufactured are given.

THE NATIONAL GAS ENGINE COMPANY, Limited, Ashton-under-Lyne, near Manchester.—A copy of the firm's new publication, "National Productions," comprising gas, oil and petrol engines and suction producer gas plants.

CHAMBERS, SCOTT AND CO., Limited, Motherwell, and 68, Victoria-street, S.W. 1.—Folder of cranes, winches, capstans and hoists, also lifting and hauling machinery. A calendar is printed on two sheets of the folder.

FREDK. BRABY AND CO., Limited, Petershill-road, Glasgow.—Copies of the following publications are to hand:—Eclipse steel tanks; Eclipse roof and side lights; steel buildings and structures; steel storage bins and furniture.

CRANE-BENNETT, Limited, 45-51, Leman-street, London, E. 1.—Illustrated list 4a, which is Section 1 of the general catalogue of British standard malleable and soft cast iron pipe fittings for pipe lines for gas, water, steam, oil and air.

CONSOLIDATED PNEUMATIC TOOL COMPANY, Limited, Egyptian House, 170, Piccadilly, W. 1.—Catalogue No. 12 E, the subject being electric tools. Different types of tool are illustrated. Catalogue No. 42, describing and illustrating pneumatic tools.

WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, East Pittsburg, Pa.—A new catalogue 6-M of the Westinghouse line material for mines. It is fully illustrated. A leaflet on the Westinghouse dry type electric glue pot with rheostatic control.

BUCK AND HICKMAN, Limited, 2, 4 and 6, Whitechapel-road, E. 1.—A copy of a data book entitled "The Gear Behind the Car." It sets forth the methods used in the construction of the E.N.V. motors, which are manufactured by E.N.V. Motors, Limited, Willesden, London, N.W. 10.

EDGAR ALLEN AND CO., Limited, Imperial Steel Works, Sheffield.—A new booklet on special alloy tool steels. A handbook of the Edgar Allen intermediate steels, their scope, character, performances, uses and treatment. "Drill Data" is the title given to the third edition of the firm's pamphlet.

CHARLES A. MATTHEWS, 47, Whitelow-road, Chorlton-cum-Hardy, Manchester.—Pamphlet entitled "The Patent Lenix Belt Drive *not* an Ordinary Jockey Pulley." Mr. Matthews is the sole British agent for Compagnie Universelle des Transmissions "Lenix," 5, Rue Fenelon, Paris.

HERBERT MORRIS, Limited, Loughborough.—The following lists, dealing with various classes of Morris manufacture, have been received:—List 101, Morris electric overhead cranes; List 606, Morris hand overhead runway; List 766, Morris retort chargers; List 830, Morris tubular shear legs.

WHITE'S INJECTORS, Limited, Pendleton, Manchester.—List A.C. 1, accessories for injectors and ejectors; List O.B. 1, White's oil burners; Section I., exhaust injectors; Section IV., steam wagon injectors and lifters; Section V., standard injectors; Section VI., ejectors and heaters; and Section XII., fire appliances.

MARSHALL, SONS AND CO., Limited, Gainsborough.—Section No. 11B, Publication No. 1292, contains description and illustrations of the steam traction engines manufactured by the firm. Publication No. 1258 on the "Marshall" method of boiler construction, showing corrugated fire-box crown, corrugated tube plate and reinforced front plate.